DESIGN RESEARCH IN THE FASHION SECTOR: DECISION-MAKING SUPPORT METHODS AND INSTRUMENTS IN DESIGN
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1. Introduction

by Chiara Colombi

This paper assumes the fashion sector as a privileged field for the observation of several research and product development processes that have noteworthy similarities and potentials of application in many other design oriented sectors. The fashion field has, in fact, elaborated research procedures and planning instruments over time, which are rather unique (such as trend research practices) that are also reaching out of this specific sector. In addition to elaborating and developing finished products, fashion companies, and other bodies, such as private agencies or associations, perfect intermediate outputs of the research and product development procedures, which they implement by using both distinctive languages that are, by now, codified and planning potential scenarios – planning trends – whose aim is not to supply homologous development instruments for collection development, but that of offering design opportunities meant to support the creativity of the companies, thereby offering multiple visual scenarios.

The design of these intermediate products highlights an area of strategic research for the development of decision-making support methods and instruments in design, thanks to which it is possible to shift from trend research practices and forecast analyses (probability) to the building of “possible futures” (likelihood), no longer having the objective of looking for trends but having the objective of “creating worlds”.

The production of these “research products” – trend books – represents a field of noteworthy interest, not only for the fashion market, but for many other design-oriented sectors that are progressively elaborating similar practices. In these, what takes on a greater value is the planning research project, instead of the finished product, since this becomes the instrument of the company’s strategy, whose potential effects do not regard a simple collection or family of products, but entire generations of products. The objective of this paper is to offer an overall view of these practices as well as to demonstrate the progressive convergence of sectors that are apparently very distant from one another, as for example, fashion and electronics, towards the said practices.

2 – Design as conceit of possible worlds

by Giuliano Simonelli

Future is the product of transformation that stems from all the elements that make up present and past and which are combined in a number of almost infinite possibilities.

In our representations of the social reality it is difficult to control the elements that may distort our judgment or be the cause of error. When changing from a common sense cognitive approach to a scientific cognitive approach it is necessary to rebuild in a rigorous way the features of any phenomenon of social importance and the circumstances in which manifests itself.

For this reason, it is necessary to carry out specific research with the aim of broadening the information available, taking into account the reality of the social and territorial environments in which the phenomenon occurs. It is necessary to research, acquire and organise new data.
The data must then be analysed and described objectively, and for a better understanding measurements or typologies of the analysed phenomenon can be proposed when necessary. Data must then be compared in order to find an explanation for the phenomena analysed and then interpretations can be put forward.

For this purpose, research activity has been coded as part of social sciences and economic sciences, shifting from a system of laws to a system that interprets reality, progressively moving from the objectivity of quantitative methods to a qualitative convergence of analysis and interpretation methods used by project disciplines such as design.

The need for alternative operating design methods arises when the concept of scientificity, which generates the need for a structured and shaped approach, is combined with the concept of complexity.

Often the term innovation is linked to white coats and labs full of unknown machinery; in other occasions one has the perception the innovation comes from the market, from listening to people for whom the products are made. However are there other forms of innovation, which go beyond the already well known “technology pull” and “marketing push” innovations?

Recently the definition of a new innovation concept, defined as “design driven” innovation, has developed and is being established. This innovation is not necessarily linked to technological innovation nor to sophisticated market analysis, but its driving force is given by the design capacity.

Design-driven innovation refers to reconfiguration processes of value creation that are the result of the generative (i.e. capable of giving birth to unexpected solutions) interface between technical potential (the “field of what is technically possible”) and social potential (the “field of what is socially possible”). In order to take place, this interface calls for a special ability to straddle the borderline between disciplinary, organisational and linguistic areas that are normally considered different and distant (technical, economic and managerial skills, on one hand, and socio-cultural, aesthetic and communications skills on the other). A kind of innovation that involves not only products but also, in a broader view, fields of services and communication whose importance today is evermore relevant, within the whole process: from the definition and anticipation of needs to the ways in which the product is launched nowadays as well as consumed (in a more aware way) by the users.

A good example of this kind of innovation can be seen in the Italian production system where the success of Made in Italy products is seldom related only to technology and where the real strength is given by the design of new qualities that often crosses all the above mentioned borderlines. This kind of innovation allows these Italian companies to acquire a competitive advantage over firms, in many cases bigger and better structured, involved in other national economic systems.

Within design praxis, metadesign is not simply an analysis instrument but a research practice for design solutions, which takes into account market anticipation needs.

It doesn’t consider only creativity practical tools. As Cristopher Alexander said, at the beginning of the ′60, the number of information needed to solve a problem is large and grows so fast that the designer is not able to collect data neither to use them.

To design always means to manage information; to reach knowledge, from different disciplinaries, as a sort of cultural and experiential warehouse able to feed the creative process: from
the memories of the past to films, from travels to music, from new frontiers in materials to new available technologies etc.

Today more than ever, in the knowledge society, in which knowledge has assumed a strategic role, even if there’s also an excess of information, the ability to reach and quickly manage relevant number of information and knowledge, from different sources and heterogenous documents, more than ever represents a crucial aspect for designers.

Design research is consequently concentrated on solutions and modalities through which it can be possible to build up meta-design warehouse and to permit the access, as a sort of structurated knowledge available for those who work in creative system.

Specifically, working on instruments for knowledge management, whose origins are to be found in the field literature, means to reflect on methodologies and instruments able to allow the access to information and the management of knowledge with modalities coherent to the design nature, as, for example, the not-linearity and the dominance of visual documentation.

In fact, for instance, if enterprises of relevant dimensions are able to create a their own system of changes and trends, new technologies and new materials rilevation etc, for small and medium enterprises and free-lance designers this is not possible. For this reason it’s important to realize more sophisticated research and design instruments to allow the access to real design knowledge “data banks”.

Working on anticipation is an industrial must. Classic industrialism did not require forecasts as the market was not saturated and the functional and aesthetic ageing of a product was solved by orienting the product to a new target.

In the last thirty years, with the arrival of just in time, anticipation has become increasingly useful for the acquisition of a stock of materials and semi-finished materials as much as possible in line with a consumption trend which is increasing in quantitative terms.

Nowadays, there is crisis in anticipation for production purposes every time a consumer and his ego, increasingly educated to consume, seek justification for the obsolescence of goods through new stories that can be interpreted by the actors of the worldwide object system, in other words the brands.

Anticipation is returned through clear and usable processes that are aesthetically in tune with the sensitivity of the recipients; many try to anticipate but only a few are satisfied with the role of relating at best the anticipations of the forecasters for production use. Therefore, we can say that to anticipate it is sufficient to reproduce the existing cultural system for the purpose of production so that it can then develop and create its own conscious ability to translate this culture through goods. In a reality with different futures, to propose a future, i.e. anticipate, put forward (design) ‘possible worlds” means offering a possibility to decision makers.

Starting from these observations, inside the Politecnico di Milano system, in which Design Faculty, INDACO Department and POLI.Design Consortium operate, was developed TR&NDs LAB – Trend Research & New Solutions Design Laboratory. A Laboratory for research and development of new trends, scenarios and design solutions starts from the needs of monitoring, understanding and interpreting the evolutionary tendencies of different productive fields of Made in Italy in order to characterize opportunities of knowledge transfer and integration and to activate coherent modalities of innovation management.

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1 Cfr. Ciuccarelli P. e P. Innocenti (a cura di), DesignNet. Knowledge e Information Management per il design, Atti del seminario internazionale, Milano 8 febbraio 2002, Edizioni POLI.design, Milano 2002;
Trendlab is based on some main hypothesis:

- Innovation is produced not only inside traditional research centers, but also in everyday life;
- Innovation is the outcome not only of top-down processes but also of bottom up ones;
- There isn’t only technological innovation, but also social, organizational or design driven innovation;
- The success of the made in Italy has been mainly the result of these last forms of innovations rather than of technological innovation.

The Laboratory takes advantage from multidisciplinary competences of researchers, professors and professionals who operate in the design system and takes benefit by the international partnerships in education, research and applied research level.

The approach, the methodology and the instruments are typical of the design culture and include social research instruments, innovation theories in technical-productive systems, user-centred design and use contexts centred design, aesthetic-sensorial-perceptive qualities of the artefacts design, interpretation of production territorial systems and productive row organization.

The Laboratory offers trends research products, as evolutionary scenarios and design solutions, and educational products to allow customers to deepen tendencies research.

Assomostre, Italian Association of the Exhibition Agencies, is the main partner. With its collaboration, a pilot program will be developed in order to characterize crossing development tendencies and innovative design concepts for exhibition system.

The program is financed by Lombardy Region through European Social Fund.

3. Cultural models and prototypes: the project of possible futures

by Chiara Colombi

The fashion sector represents a field in which interaction with cultural contexts has gone beyond the “natural” immersion of designers into local culture, thus becoming more formalised and articulated. This sector often tends to be interpreted in an “artistic” way. In other words, as characterised by innovative processes guided by the designer’s creative genius and, therefore, not attributable to codified processes. However, it is precisely in this sector that the importance of certain implicit practices of observation and interaction with a cultural context were observed, the said importance having been made explicit and integrated into a formalised manner within the product development process.

The said knowledge was favoured by a series of phenomena featuring the 1980’s and 1990’s. During this period, increasing international competition and, above all, the widespread of a cultural phenomenon on a global level, made that unaware activity of interpretation, and the “cultural prototype” that characterised the designer in this sector, ever more difficult. The

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2 This theme is deeply tied to the dynamics of the movements of adolescents that, from the start of the 1970’s, influenced the creation of languages and lifestyles. Up until the 1980’s, these movements were represented by very strong recognition and “localisation” and by a progressive diffusion on a global level—teddy boys, punk, American gangs. Contemporaneity is, instead, characterised by a plurality of cultures that is difficult to limit. It finds its main place of expression in urban centres, yet, it is hardly attributable to trends or homogenous cultural groups. On this theme Cfr. Gianicola A., *La moda nel consumo giovanile (fashion in adolescent use)* (edited by), Angeli, Milano, 1999; Miglietti A. F., *Identità mutanti (Mutatine identities)*, Costa & Nolan, Genova, 1997;
immersion into cultures became a consolidated and institutional standard procedure, carried out on a global level, and no longer on a local one:

“We get information from everything. We travel the world and always return with notes and impressions on things that impress us; along with books, magazines, and clothing.”

“I travel often with designers; we go to some English flea markets or some vintage store in California. […] They buy a pen, and I ask myself why they’ve bought it. […] A few months later, I find out that the colour combination of that pen was the inspiration for the choice of colours of a fabric.”

Social research, mediated by the sensibility of designers, and by their capacity of representation through cultural “prototyping” is, therefore, by now, an indispensable instrument in the creation phase of ideas throughout the fashion industry.

The fashion sector is an environment in which interception and interpretation of market consumption dynamics are the basis for continuous innovation. These elements translate an implicit knowledge into a consolidated professional procedure. Designers, as “users-innovators” immersed in a specific culture of use, have the expertise to interpret the values of a specific social community, identifying the signs of evolution before other sectors. The concept of a shared tacit consciousness and of “expert communities” capable of elaborating new cultural models represents therefore the key-concept in the analysis of research and development processes in the fashion sector.

Direct contact with different cultures of use and consumption on a global level is a consolidated procedure in the research phase. Through the use of design and cultural systems, designers mediate social research and ethnographic observation in order to propose an original and useful formulation that does not produce product concepts but possible worlds to be interpreted in the development phase through the design of new products.

This practice is now so very consolidated that it is no longer carried out only within a company. Specialised firms, the so called Trend Institutes, carry out similar functions working as suppliers for the fashion firm, producing “cultural reports” that are the result of a structure research. The work groups are comprised of experts in social sciences, sociology, psychology, and anthropology, but, above all, characterised by forms of participative research in which “user researchers” document their daily life. The result of this work is collected in synthesis, through visual language, in tried and true “research products”, in which social communities, practices, and shared languages, as well as methods of relationships and communication are described. These are documents that are no longer “descriptive”, but “interpretative”, which translate cultural models of use in “prototypes of possible futures, anticipating scenarios of

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4 Marchiori M., La comunicazione Diesel come dichiarazione di onestà nei confronti del consumatore, (Communication by Diesel as a declaration of honesty with regards to the consumer), in Gianicola A., 1999, op. cit., p. 194;
5 Bertola P., “La progettazione orientata all’utente: il caso del settore moda” in Tosi, Francesca, Ergonomia e design, Edizioni POLI.design, Milan 2004;
6 The Futur Concept Lab of Milano, directed by the known sociologist, Francesco Morace, has correspondents in all main capitals of the world. These are represented by people of a low age range, with training and education generally focalised on the humanities, on social disciplines or on architectural-artistic ones. These are young students or professionals who limit themselves to documenting or recounting their own personal experiences of life, the dynamics of relationships and communication, through images and documents of various nature.
7 Cahier de Style and Trend Books are diffuse instrument in Fashion System.
life, products, and customs, i.e., creating a visual platform on which new collections can be conceived. “Trend books” are, in fact, the product of the translation of the planning research into “material reality”, a visible world, comprehensible for the company, and are, therefore, already the result of an activity of planning synthesis.

The figures who intervene in this process of planning elaboration range from “bureau de style”, agencies, and professional private offices, who periodically produce trend books, and often ad hoc research upon request of the companies, to trade fairs that tend to increasingly dedicate a section of their activities to the theme of trends, as well as to firms that often carry out their trend research activities on their own. The product trend books pass through the entire product line, including very broad ranges of categories: fabrics, knitwear, print & décor, men-women, infant, lingerie, sports + active wear + leisure, accessories, and beauty.

The research methods on which the production of these categories is founded are often a hybrid between methodologies of social research and the application of instruments of visual and artistic research. These are conducted by multi-disciplinary groups, co-ordinated by artistic directors, within codified and periodic processes.

The products elaborated are scenario books, and what is relevant to these, on interesting themes for different seasons, spring/summer and fall/winter, according to the classic temporal scanning of the fashion system, with an anticipation of approximately 30 days, with respect to the introduction of the finished product on the market. The research proposed, therefore, is introduced as a reference for the entire production line, even before the yarn production sector, primary material that necessarily orients the finished product. However, these are articles that do not take on a “foresighting” perspective, but a planning approach, that is, beginning with the observation and interception of practices, languages, and new methods of use, propose “possible futures”, or worlds planned as “qualitative possibilities” and not as “quantitative previsions”.

The great anticipation of the suggestion and its reflective character on transversal themes with respect to the interpretation of emerging practices lead to the fact that the products elaborated not only refer to the fashion sector, but more generally, to the entire world of products, also in light of the growing hybridisation among sectors such as, fashion, design, art, furnishings, communication, etc.

The base product, referred to a season, can be further developed for a particular sector (fashion/furnishings/cosmetics) or for a precise category (male/female), by articulating the diverse themes in a detailed manner.

Trend research, or if we wish to use a term that is nowadays very diffuse, the planning of scenarios, does not, therefore, interest only the fashion product companies, but transversally, all the sectors oriented towards design, in which emerging practices of research and production of articles are very similar to those adopted in the fashion field.

4. Convergences among sectors and new methodological potentialities

by Giuliano Simonelli

The start of the new millennium brought with it new reasons for internal reflection that heavily invested the industrial economy. Complexities and uncertainties are nowadays elements

8 Recognized on a global level, Trend Union, bureau de style, with offices in Paris and New York, directed by Li Edelkoort, of Dutch nationality, director of the Design Academy of Eindhoven (Netherlands), consultant for Pitti Immagine and creator of four magazines, Interior View, Color View, Textile View e Bloom, at the cutting edge with regards to “trend research”.

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that are typical of the dynamics of the elaboration of practices of interaction and of lifestyles, so that organisations tend to equip themselves with new research instruments to confront that market, the said instruments involving more and more planning proficiencies, and moving closer to the practices described in the previous paragraph.

In fact, besides the fashion sectors, there are some signals in other fields regarding the chance for this “methodology” to be applied in improving products according to social and cultural evolution, as well as some cases in which this has already happened.

The natural diffusion of this process seems to be more relevant to mature products related to everyday life and routines: furniture, appliances, objects and accessories, transportation and common tools. All these products are becoming not just functional instruments, but also a means to organise relational and social interaction, in the quest for pleasant sensations and cultural expression. Despite the still present scepticism regarding fashion phenomena as a way to create needs, there is a rising interest in the field as a context in which pluralism and differentiation are now the main issues according to social groups and cultures. Furthermore, it is not by chance that the same “research firms” which worked for fashion business now are extending their interest in topics, such as “home living cultures”, “work and technology”, “mobility habits”, and sell their “cultural prototypes” in other fields, as well – see the case of Future Concept Lab in Milan.

A really interesting context where “cultural prototyping” can find applications relating to high and new technology. The nature of new technologies is more and more disconnected from functions and uses, being instead introduced as a platform to be applied and combined in many different ways and with many different purposes. A “cultural prototype”, describing users’ cultural evolution and trends, can introduce new opportunities offered by technology where traditional “Research and Product Development” departments are no longer able to understand and explore. Many high technology businesses, including Siemens, Philips, Nokia and Motorola, are creating design research groups inside their organisations, disconnected from business processes, which seem to apply similar methodologies. These groups can function as consultancies for the company, but can also work for other businesses and often develop research projects not related to specific products nor technology, but similar to “cultural prototypes”.

The Philips design case is certainly interesting in that it started a process of planning research oriented towards producing planning scenarios capable of offering a strategic orientation for the company and producing effects on entire families of products.

At the end of the 1990s Philips Design, riding the wave of Stefano Marzano’s vision, realised the highest number of “visionary” projects for different design consumer sectors.

The creative, production and development process of Philips Design stems from the basic concept that there isn’t any expert capable of knowing and guessing everything, but rather, there is a broad system for the collection of information and intuitions. With this way of working, Marzano has tried to institutionalise and formalise a codesign process partly developed by the users. In this way, the presentation and communication of products provide the company with information which can be used to imagine new scenarios: design experiences. Philips design represents the application of this approach and it pursues the materialisation and realisation of new visions to produce artefacts which can be valued in terms of categories different from the traditional nice/ugly, useful/useless, price, detail criteria. Designers at Philips Design gradually reach a design sensibility as regards the new social, cultural, technologi-

9 Stefano Marzano, architect, Managing Director at Philips Design since 2001;
cal and business attractors with the objective of obtaining a product system in line with the scenarios perceived by the company and the consumer.\(^{10}\)

Even if this strategy supports knowledge exchange and is a source for creative vision it seems to be effective only when design processes are not completely “externalized”. As in fashion companies, the part of design processes called “cultural prototyping” become effective only if the design competencies inside businesses transform and translate it into products, according to core competences and organizational knowledge. Cultural prototypes are creative sources not directly related to business purposes, but for this reason they need to be integrated with an internal design process.

The convergence between practices and design driven research adopted in different sectors, however, represents an important signal regarding the prospect of the improvement of planning figures, especially within the initial phases of definition of strategies relevant to the development of new products. The activity of planning research related to trend production and scenarios, is seen as an innovative instrument in a phase of great uncertainty, with respect to reading instruments for the dynamics of use and with applicative potentialities absolutely transversal to many industrial sectors.

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APPLIED RESEARCH AND INNOVATION FRAMEWORK

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Abstract

This paper explores industrial (product) design domain and the artifact’s contribution to knowledge generation. It discusses the artifact’s research situated within the social structure that constitutes people, activity, context and culture where an artifact is position to be a “mediator” for the generation of new knowledge and its application. Within this concept the generation and application of knowledge were distinguish through the following four research modes: (i) research before the design work is started, (ii) concurrent research conducted during the early stage of the design process, (iii) concurrent research carried out during the design and development stage and (iv) research when an artifact is manufactured and is on the market. The paper demonstrates how new knowledge can be generated by research around the artifacts as “mediators of knowledge”, how this new knowledge is represented by them and how it can be applied. It also clearly distinguishes strategic role of research and design within the different research modes and supports integration between research and application.

Keywords: research and design, innovation, product design, knowledge, practice

1.0 Introduction

The understanding of human interaction with an artifact is an essential part of design and the Industrial (product) design’s main contribution is to act as an integrator for the range of activities associated with people’s interaction with products and services. In this context the artifacts are playing an important role. They are contributing to knowledge or new knowledge building that is generated by research. The artifacts are not to be seen in isolation they exist within their own context. Several theoretical constructs have been explored in developing this concept. They are grounded in Human-computer Interaction (HCI), social sciences, cultural studies and design domains (Popovic 2005).

2.0 Applied Research and Human-centred Innovation Framework

This paper is exploring an applied research and innovation framework that aims to situate design research within the social context (Popovic 2003, 2005) by describing its potentials to generate new knowledge and support innovation. The research is situated within the social structure that constitutes people, activity, context and culture where an artifact is positioned to be a mediator for the generation of new knowledge and its application (Figure 1).
Figure 1 illustrates the artifact design paradigm shift that moves from designing an object to designing for an experience. The design knowledge sources identified are people, processes, products (Cross 1999) and experiences within the activities, culture and context (Popovic 2000). Within this concept each interaction between people can be seen as unique; one of the ways to explore these relationships is by researching and generating new knowledge and theories from them by focusing on their innovative aspects. It is also understood, that the knowledge derived from the study of people's interaction, within a context and culture, is the main knowledge that contributes to innovation and brings relevant cultural characteristics to be applied to an artifact design (Popovic 2000, 2005). Therefore, within this context applied research refers to the research undertaken within the given framework in order to acquire new knowledge that is directed toward innovative applications.

The theoretical construct of artifacts as mediators of the activity (Kuutti 1991) has been transferred to the artifact concept of being mediators of knowledge generation and utilisation. It is a continuation of the work reported at the “Design plus Research” conference (Popovic 2000) where the generation and application of knowledge were distinguished through the following four modes:

1. research before the design work is started
2. concurrent research conducted during the early stage of the design process
3. concurrent research carried out during the design and development stage
4. research when an artifact is on the market

3.0 Research Modes and Human-centred Innovation Framework

The research process presented here consists of four modes which might occur in any order. Within these modes each research example is situated within the social framework (Figure 1) consisting of people, activity, context and culture.
3.1 Research before the design work is started

This research mode is based on utilisation of relevant qualitative or quantitative research methods in order to acquire knowledge to be applied to an artifact design. For example: the knowledge might be generated from a context, activity, life style and human interaction. The new knowledge generated can be applied to a scenario in order to predict users’ experiences with artifacts and systems. This might convey human’s concepts about an activity or artifacts as well as their intentions. This is demonstrated by the research example presented in table 1.

Table 1 Research Example - Research into Context of Use

This research is concerned about the context of use and users experiences within the product design domain. Its research question’s main inquiry: “how can the design of product usability be improved in the early stages of the design process?” has been driving the research. One of its objectives has been to identify the aspects of experience and context of use that affect usability of everyday artifacts. It also aims to identify the differences between a user’s and a designer’s concept of context of use. Research questions and their theoretical foundation grounded the methodological approach of the study. The research plan consisted of three stages: (i) experiment, (ii) analysis and (iii) findings. The participants in the study are artifact users and designers. Artifacts are selected from a diverse context of use. The instruments for data collection are observations, visual representation of concepts, retrospective verbal reports and thematic interviews. Interpretations of data and a coding scheme have been developed within three main groups: (i) experience, (ii) concept and (iii) context of use. Some coding sub-categories are: features with indication of context of use, individual experience within context, episodic data, principled-based concept, descriptive-based concept, intended use and situation. The initial findings provided the knowledge about the user and designer differences related to their concept of context of use. The key difference was that user concepts were based on their experience while the designer concepts were interpretative and descriptive. The expected outcome of this work in progress is to utilise this new knowledge in the development of the model(s) of context of use.

The newly obtained knowledge resulting from the research into context of use (Table 1) will potentially have various applications including the better understanding of user experiences in various contexts that are “mediated by artifacts” or “product scenario” based on context of use. This will assist designers in interpreting the context of use of artifacts they design in the early stage of the design process (research mode two). They will be able to predict user experiences of various concepts of use and build scenarios around them. Ultimately, it has the potential to strategically drive the direction of an artifact/system design that could lead to an innovative outcome. It also has the potentials to generate new market niches by identified new products that are emerging from the research of human’s activities.

3.2 Concurrent research conducted during the early stage of the design process

The early stage of the design process is seen as the most significant phase where artifacts are conceptualised by design teams. This stage is crucial to the generation of an innovative design. This is understood to be the most creative phase that encompasses visual searches and analytical tasks. The major component of this early stage of the design process is devoted to the translation and analysis of research findings and the implementation of design constraints (Popovic 1996). This is the stage where user’s concepts derived from a scenario should be tested. The testing can be conducted by applying relevant qualitative research methods (eg. interviews, focus groups or protocol analysis). At this stage several design concepts usually
emerge. Their representation is done in sketches and annotations with critical reflection and/or evaluation occurring during the design process (Table 2). This enables a designer (design team) to identify, recall and apply the relevant knowledge required (Cross 1999).

3.3 Concurrent research carried out during the design and development process

In this stage additional research may be conducted in the appropriate area that includes (a) detailed concept design, development and user testing, (b) final design development and user testing, (c) user testing and prototype usability, (d) product perception and cultural values. The number of different experts that are contributing to the design and development of a product/system share their relevant knowledge within the design and development team. Nevertheless, this knowledge is integrated by designers and represented in an artifact visual form. (Table 2)

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<th>Table 2 Research Example: Pipe Measuring System</th>
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<tbody>
<tr>
<td>This following research example illustrates the second and third research mode. The example is from the petroleum industry and focuses on pipe measuring in particular. The artifact was situated within the social framework constituting context: petroleum rigs; activity: pipe measuring; people: petroleum rig personnel; culture: western (sub-culture related to the specific petroleum drilling environment and its personnel). Prior to the design stage the needs for a pipe measuring device and its context of use were identified. The early stage of the design process focused on its form and usability. Different trials were conducted to assess its suitability related to the activity that personnel were required to perform and the resulting knowledge from the context and activity was applied to the design. Concurrently, the laser optic was developed and tested. During the development stage, technology was integrated and device interface developed. User trials of the device were conducted. Knowledge and information search were evident during developing the artifact. Pipe measuring personnel were active participants during the design and development process.</td>
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It has been evident that research modes two and three focus on interpretation, translation and implementation of design constraints. The research occurred concurrently during the design process, when appropriate (eg. usability trials or laser technology testing). The relevant knowledge generated (research modes: one, two and three) was applied to the design. This was demonstrated by the artifact’s visual form which may convey its values and respond to the context and activity for which it was designed. Integration of knowledge occurred within these two concurrent research modes. Both modes support design innovation by applying the knowledge generated from the research into relevant designs.

3.4 Research when the artifact is constructed and is on the market

In this mode different aspects of artifact/system are researched. They may include: artifact usability, product cultural response related to its visual attributes, intuitive use of products or compatibility between a user and the design concept. The research findings are usually applied to improve the particular product or be utilised to explore new strategic opportunities. The research findings can generate new knowledge to be applied to the design of the next generation of products (eg. aeroplanes, computers).

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<th>Table 3 Research Example: Driving Experience</th>
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<td>This research project is concentrating on driving and experiences that affect the activity. It investigates drivers’ experiences with a vehicle in a real situation. The artifact’s social</td>
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framework consists of - context: urban; activity: driving; people: university staff; culture: western. The research is based on the triangulation approach including interviews, observations and think-aloud protocol. Participants were asked to perform specific tasks while driving and were interviewed before and after driving. During the drive they were video and audio taped. The theoretical framework was based on activity theory and studies of emotions in which an experience is defined within an activity through time and within context. The experience in this case is exploring the relationships between humans, product and overall activity within a context. The aim was to identify aspects that may have affected the driving experience. The findings demonstrate that context plays a significant role in determining the overall driving experience. In particular circumstances, overcoming challenging interactions with the driving interface lead to positive experiences.

Table 3 research example provided knowledge how different aspects of driving experience affect the emotional conditions of the driver. It identified that context plays a significant role in determining the overall experience of the driver. The knowledge generated has potential applications to an interior of a vehicle (eg. context aware interfaces or interfaces utilising smart materials). It can help to support positive interaction in a variety of contexts and increase the safety of the driving activity. In this case the utilisation of new knowledge leads to a new design and discovery (eg. next generation of vehicle interface designs). It supports the strategic role that research plays in creating new potentials for market niches creations and commercial opportunities.

4.0 Human-centred Innovation Strategic Significance

The applied design research contribution to innovation and new product design and development is outlined in this paper by pointing out the research significance of each research phase and how the new knowledge might be generated and utilised. This is further summarised in Table 4.

<table>
<thead>
<tr>
<th>Research Modes</th>
<th>Research Contribution</th>
<th>Research Significance</th>
</tr>
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<tbody>
<tr>
<td>Before design commences</td>
<td>• new knowledge building;</td>
<td>• strategic</td>
</tr>
<tr>
<td></td>
<td>• identification of new artifacts</td>
<td>• generates innovation</td>
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<td></td>
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<td>• market advantage</td>
</tr>
<tr>
<td>Concurrent research - early design stage</td>
<td>• knowledge building and application</td>
<td>• generates innovation</td>
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<td>• market advantage</td>
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<td>Concurrent research - design and development stage</td>
<td>• knowledge building and application</td>
<td>• generates innovation</td>
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<td>• market advantage</td>
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<tr>
<td>Finished artifact</td>
<td>• new knowledge building for new or next generation of artifacts</td>
<td>• strategic</td>
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<td></td>
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<td>• generates innovation</td>
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<td></td>
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<td>• market advantage</td>
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It is well known that the interaction between people and artifacts has existed for centuries. Its complexity has increased in parallel with the development of human civilization. Nevertheless, the impact of cultural factors did not receive appropriate attention in respect to innovation as the
real innovation 'always represents a new social value unknown before' (Szántó 2001). Nowadays, societies are trying to demonstrate differences at all levels. This is becoming an indicator for the identity of companies or a country. However, innovation should not be produced for the sake of change but for the sake of achieving an excellence that would contribute to the social and technological development of the society.

Within the globalisation that is taking place innovation has an impact on market competitiveness as well. It has reached the level of industrial scale application all over the world (Quinn, Baruch and Zien 1997). Within the proposed framework (Figure 1) innovation is seen as an introduction of change by implementing 'new benefits' that can be accepted by people. It occurs within a human-centred innovation framework and it is generated by people. Therefore, it is recommended to look for knowledge sources within the innovation framework (Figure 1). In this instance, research should be directed toward new or significant contributions to knowledge, where the knowledge sources are generated from people, context, activity and culture. This is demonstrated by research examples (Tables 1, 2 and 3). The proposed concept is supported by the studies that relate to how artifacts mediate between the users and object and one of these studies states that ‘tools [artifacts] mediation is a way of transmitting cultural knowledge’ (Kaptelinin 1996). Indeed, ‘…some cultural anthropologists have long seen the artefacts we create as the medium through which cultural identities are preserved and communicated to subsequent generations’. Nardi (1996) states that ‘all human experience is shaped by the tools [artifacts] and sign systems we use’. Tools [artifacts] shape the users’ activity and can even influence their goals. Suchman (1987) pointed out that an activity would grow out from the situation while Kuutti (1991) introduces the main idea that artifacts mediate the activity. The latter theoretical construct has been transferred to the notion of artifacts (products) as mediators of knowledge generation and utilisation (Figure 1). Therefore, within this context the innovation characteristics are:

- New knowledge building: This knowledge is generated through research and later applied to an artifact or system design. Requires strategic positioning and planning. People oriented: It should be generated from people, their activities, culture and context. Rewarding: provides market advantages and creation of new market niches.

5.0 Conclusion

This paper explores how research can be situated within the social structure. It showcases the ways in which new knowledge can be generated to their outcome. The examples demonstrate the focus of each research mode. Two research stages (i) research before the design work is started and (iv) research when an artifact is on the market are identified as strategic for creating new market niches. This is based on the premise that innovation occurs within the activity and it is generated by people. In this context innovation is seen as an introduction of new changes that are beneficial for people and are accepted by them. Therefore, knowledge generated from activity, culture, context and people can identify the new strategic direction for design of artifacts, systems and services. This concept also supports the diversification of innovation within international market as it derives from people and their culture. The potentials of this framework are to support new designed products and services to be innovative and human-centred. Therefore, design is seen as contributing factor for knowledge integration while the knowledge is seen to be the resource to support and promote innovation.

References:


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Research studies examples are part of the research program in Industrial Design at the Queensland University of Technology, Faculty of the Built Environment, Brisbane, Australia.

1. Marianella Chamorro-Koc, Research into Context of Use (PhD in progress)
2. James Stuart, Design and Development of Pipe Measuring Device for Petroleum Industry (Masters by Research)
3. Rafael Gomes, Driving Experiences (Masters by Research)
THE VIRTUAL PROTOTYPE AS AN EVALUATION TOOL IN THE INTELLIGENT-CLOTHING DESIGN PROCESS
Mari Pursiainen, Riikka Matala, University of Lapland, Finland

Abstract

This paper describes a study of the implementation of virtual prototyping as part of the process of designing intelligent clothing. Virtual prototyping is used to visualize the results of the concept-design phase for the end-user. Thus, the end-user is involved in the design throughout the process, from studying the context and users’ needs to the evaluation phase before production of the physical prototype. The goal is to find new models and methods for design, and to use virtual prototyping to reduce the number of expensive, time-consuming physical prototypes. The virtual prototype has to be a usable instrument for data collection by researchers and for evaluation by end-users.

1. Introduction

This paper outlines the role of the virtual prototype as an evaluation tool and the challenges it must meet. As background to the development of the tool, there is a brief introduction to how the usability of intelligent clothing is understood and why certain methods are chosen for evaluating intelligent clothing. The goal of the Methods and Models for Intelligent Garment Design (MeMoGa) research project was to carry out a user-centred concept-design process (see Säde, 2001) for intelligent clothing, from the background research to the concept-design phase. A virtual prototype and an interactive multimedia presentation were then developed from the material from the concept-design phase and used in a usability evaluation of the concept. The evaluation is structured so as to provide more information about the usability and acceptability of the intelligent-clothing concept, and to study ways of conducting evaluations of clothing concepts in general. Usability evaluation using a virtual prototype will enable researchers and designers to analyze concepts in an early phase of product development and to eliminate design errors and shortcomings. (Mäyrä, Matala & Falin, 2005) Virtual prototyping is also used to gather material for studying how informative, communicative and usable the virtual prototype and presentation are in general in this context. This study is part of the Facilitating Social Creativity through Collaborative Designing (CoDes) research project, one aim of which is to explore how new media and design technologies can improve design communication.

2. Usability evaluation of intelligent clothing

The term ‘usability’ is rarely used in the context of clothing, even if numerous trials are conducted during the design process, including fit testing and field testing to investigate how the clothing works in practice, usually accompanied by observations of functionality and aesthetics. (See Choi & Ashdown, 2002) Determining usability is important when designing intelligent clothing that may take a long route from idea to end product. Intelligent clothing often consists of electronics, e.g., mobile-phone technology, embedded using conductive fibres and more traditional electronic components. This makes the process more complex, time-consuming and expensive than ‘traditional’ clothing design. That is why usability evaluations using a virtual prototype can be an important stage in the presentation of the concept to the end-user and for minimizing faults in the physical prototype.

2.1 Towards usability evaluation of intelligent clothing

Usability can be seen as indicating how easy a product is to use. A more formal approach to usability is the description by the International Standards Organisation, which defined usability as the effectiveness and efficiency of a product. The former refers to the extent to which
the goal is achieved and the latter to the amount of effort required to accomplish the goal. (Jordan, 2001) The usability of intelligent clothing can be based on these definitions, but when usability is researched using a virtual prototype, and carrying out real tasks with the clothing is impossible, usability should be understood differently. That is why the usability of clothing should be analysed using clothing theories. (See Uotila & al., 2002)

To define the usability of clothing, the FEA model was chosen, which has been developed by Lamb & Kallal in a framework called the ‘Consumer Needs Model’. This provides a basis for the intelligent-clothing design process, from the background research and design phase to production of a virtual prototype and of a questionnaire to conduct the evaluation. The FEA model suggests that the (F)unctional, (E)xpressive and (A)esthetic properties of a garment are inseparable parts of a whole, and there is no reason to distinguish between functional-apparel design and fashion design. All three elements should somehow be present in the design process, as well as in the final product. The emphasis on the three elements can vary according to the garment’s primary intended use. Functional properties are clearly emphasized in workwear, but expressive and aesthetic properties are still relevant to some extent. (Lamb & Kallal, 1992) The FEA model is expanded into a framework called ‘Apparel Product Appearance Factors’ using the FEM model. This takes the user’s body into account in three different ways: (F)orm, (E)xpression and (M)otion, which are incorporated into the analysis of the appearance of the clothed body. (Kallal, Keiser, MacDonald & Stefan, 2002)

2.2. Materials and methods of usability evaluation

The evaluation of the usability of the intelligent clothing concept is based on two previous versions used in projects in 2001-2003. (University of Lapland website; Uotila, M. & al., 2002) Both evaluations were conducted using qualitative methods, with the discussion guided by a semi-structured data-gathering framework. To find out how quantitative and more independently executed methods might help conduct the evaluation in a faster, more economical way, this third version tried out three different methods.

The three methods were chosen according to Jordan’s (2001) guidelines on conducting empirical usability evaluations. Earlier versions of the evaluation used individual semi-structured interview and co-discovery methods, both time-consuming, qualitative methods. These experiences prompted the idea of developing quantitative and more independent methods using interactive multimedia and virtual prototyping. These more independent methods use a web-based ‘kiosk’ and a laptop-based ‘kiosk’. Participants get a website address where they can make their evaluation at any time, e.g., using their home computer. The same multimedia presentation is run on a laptop-based kiosk for semi-independent use. This is set up at workplaces for a given time, with technical support provided for end-users taking part in the evaluation. To ensure that the evaluation provides sufficient information about the concept, the co-discovery method was also used. The advantage of this method is that there is no interviewer in a traditional sense in the evaluation situation, so the discussion can flow quite spontaneously. This makes it possible to get data that cannot be obtained using, e.g., a structured questionnaire or a strictly structured interview. The disadvantage of this method is the analysis of the qualitative data, which provides no concrete information and is time-consuming. (Kemp & Van Gelderen, 1996)

The concept evaluation was carried out among workers who use workwear either daily or periodically in their work, or when visiting heavy-industry factories. The laptop-based kiosk produced less than 30 evaluations and the web-based kiosk less than 20. Fifteen people were invited to conduct the evaluation during a working day using the co-discovery method.
3. The role of the virtual prototype in evaluating intelligent clothing

In our case the virtual prototype was intended to assist users in assessing the applicability of the proposed solutions. We focus on three main roles played by the virtual prototype in the evaluation process. These are: 1) to present the designed concept to the end-user; 2) to guide the communication and evaluation process, and to arouse discussion; and 3) to be a usable instrument for data collection from the researcher’s viewpoint, and for evaluation from the end-user’s viewpoint.

3.1. The informative aims of the virtual prototype

The virtual prototype is defined to give a degree of realism and functionality comparable to that of the real object and to provide a multi-dimensional view of the product. Its purpose is to allow designers or users to examine the quality of the product through impressions given by the virtual prototype. (Leppälä & al., 2003) Our study involved two vital questions about how to simulate features of the clothing concept: 1) What key features are required for a virtual prototype to provide a sufficiently versatile view of the concept?; and 2) What degree of realism and functionality is required? It is essential to use concrete models when users are involved in the process, since they cannot deal with abstract specifications. Thus, the level of abstraction must be decreased and the amount of context around the product increased when the viewer is the end-user. (Säde, 2001) Although our presentation of the concept does not include tangible models, our objective has been to use virtual prototyping to produce models that are concrete enough for evaluation purposes.

In defining the informative aims of the content of the prototype, we have used the model shown in figure 1. Each aspect: garment, body and context, is divided into three subcategories. In defining the subcategories for the garment aspect, we used the same FEA model as in the concept-design process, and this was expanded with the FEM model when defining the body aspect. From the prototyping viewpoint, this framework is used to define the elements for visualizing the virtual clothing and virtual user. A context aspect is also needed to define the simulation features for the context of use. The main purpose of the virtual prototype is to present the functional, expressive and aesthetic properties (FEA) of the concept in as informative a manner as possible. Visualization of the body, i.e. the potential user, is crucial when presenting the garment with regard to bodily proportions and to facilitating the end-user’s self-identification as a prospective user. In visualizing the body to give sufficient information we considered the form, expression and motion attributes (FEM) for an avatar model of the employee. Another important aspect is visualization of the physical, cultural and social context of use, since simulating the role of the concept for the user, environment and situation of use is vital especially for evaluating the properties of complex intelligent clothing.
In defining the informative aims of the means used to express the virtual prototype’s contentual elements, it is useful to examine the Houde & Hills model of what prototypes prototype. They emphasize that it is more productive to examine prototypes through their purpose than through such attributes as the tools used to create them or how refined-looking or refined-behaving they are. Their model consists of three perspectives for analyzing the essence of the prototype: role; look & feel; and implementation. Role refers to questions about the function, such as usefulness, that an artefact performs in a user’s life. Look & feel denotes what the user looks at, feels and hears while using the artefact. Implementation refers to the techniques and components via which an artefact performs its function. A fourth aspect is also introduced: the integration prototype, which explores the balance between all three main dimensions. The actual prototype can be any representation of a designed idea, regardless of the medium. (Houde & Hill, 1997) In our case the purpose of the prototype is to be an ‘integration prototype’. This prototype concentrates on the role and look aspects. It is known to be difficult to simulate the feel aspect in the virtual prototyping of clothing, thus the feel aspect was expressed by visualizing the look and structure of the fabric. Implementation of the concept was less important than the other factors, because the prototype was not used to evaluate a production-ready design.

In our case the virtual prototype consists of several elements: pictures and explanatory texts, 3-D animations and interactive 3-D models. These materials are included in the interactive multimedia presentation. A narrative 3-D introductory animation (ca. 4 minutes) including a mobile, dressed avatar figure of the end-user with dialogue and an environment with audio, simulates features of the physical, cultural and social context in which the clothing would be worn and used. The introduction animation also shows the functional, expressive and aesthetic features of the concept including the form, and the expressive and motion features of the end-user avatar. The introductory animation was the most versatile presentation medium in terms of its ability to simulate the different features of concept ‘horizontally’, but not in great depth. The presentation also uses close-up 3-D animations, including the item of clothing under review worn by a walking avatar figure, primarily simulating the aesthetic properties of the clothing, especially the interaction with the mobile body and showing the clothing from every angle. In addition, the presentation includes interactive 3-D models displaying each item of clothing, simulating the individual aesthetic properties of the single garment. The purpose of these models was to give the viewer the possibility of examining the garment by rotating it with the mouse and choosing the colour of the clothing. It also displays each item as a three-dimensional clothing object. The presentation also includes pictures rendered from
the 3-D models and explanatory texts, giving more detailed information about the functional, expressive and aesthetic properties of the concept. (See Figure 2.)

FIGURE 2. Screenshot from the multimedia-presentation interface (Pursiainen et al. 2005).

3.2. The communicative aims of the virtual prototype
In addition, the virtual prototype was intended to facilitate and initiate the communication between researcher and end-users. Representations of designs aid communication, making abstract ideas tangible and providing a common language. Evaluative communication with end-users is possible when the abstract ideas are represented in an explicit, understandable form. The reasons for prototyping can be put into three broad categories: idea generation; communication; and testing. They are all intended to be a basis for decision-making. (Säde 2001) Our study does not adopt the perspective of using virtual prototyping for decision-making during the idea-generation phase. In our study the main goal of virtual prototypes is to provide a basis for decision-making in the usability evaluation. We examined three different usability-evaluation methods, each requiring ways of communicating with the end-user, with only the methods of interaction being different.

The usability evaluation was conducted using web and laptop-based kiosks. Thus, one aim of the interactive multimedia presentation and the prototype was to enable as independent an evaluation process as possible. Using the virtual prototype further allowed us to look for less time-consuming methods than co-discovery. That is why the multimedia presentation includes questionnaire forms for the collection of quantitative data for the web and laptop databases. This Likert-scale questionnaire includes evaluation of the concept, evaluation of the multimedia presentation and virtual prototype, and a few profile questions. In these two methods, communication between end-users and researcher was limited solely to interaction through the questionnaire; so the presentation acted as an intermediary for the evaluative communication. However, the laptop-based kiosk allowed technical support from a member of the re-
search group if needed, while the web-based evaluation was wholly independent, with no possibility of direct interaction with the researcher.

The advantage of gathering quantitative data with a questionnaire is that it is a quick, cheap method conducted totally independently, since the investigator need not be present and the participant is also free of any investigator’s influence. In addition, the informant can take as much time as necessary without feeling any pressure to go forward. On the other hand, independence also makes it impossible to ensure that enough participants fill in the questionnaire, and those who complete the questionnaire will most likely be those with comparatively extreme opinions about the issue in question. (Jordan, 2001)

The test method used in our study that was most demanding from a communication viewpoint was co-discovery. In the co-discovery method the virtual prototype was intended to initiate spontaneous discussion between two end-users. In addition, the aim of the entire multimedia presentation was to steer the test situation and the evaluation process forward. The evaluation process started with the introductory animation, its goal being to prompt interest and ideas that would form a basis for the evaluative discussion. The presentation showed the concept starting from the underwear and ending with the whole outfit. The discussion was facilitated by a structured questionnaire, which was included as a fixed part of the graphical user interface. In the co-discovery situation the questionnaire form was not used to save answers to a database, since the situation was recorded on audio and video.

### 3.3. The usability aims of the virtual prototype

It was important to consider the usability features of the prototype materials and the interactive multimedia presentation, since they would affect the entire evaluation experience. The aims of the usability features take both the end-user’s and the researcher’s viewpoint into account.

In the first place, the aim was to make the various kinds of virtual-prototype materials available within the same presentation platform, so as to make it easy to view all the concept materials independently. The second aim was to design the graphical user interface to make it as easy as possible to use, since viewers are not assumed to be habitual computer or multimedia users. Therefore, the multimedia presentation started with instructions that were especially important for the web and laptop-based kiosk evaluations. We also considered usability aspects of the graphical user interface such as visual and typographic appearance and layout, navigation and structure. One of the usability goals of the presentation was to show the viewer how the evaluation process progresses. The presentation’s primary purpose was to be accessible to as many employees of the selected companies as possible via the Internet. Thirdly, the aim was to design the easiest possible way of collecting the evaluative data for the database, where the data would be easy to collate for analysis. The goal was to incorporate the structured questionnaire form into the interface in such a way that it would be generally easy for end-users to answer the evaluative questions, and at the same time to view the materials for the intelligent-clothing concept. It was extremely important to produce a reliable method for saving the given answers properly in a web-based database.

### 4. Perspectives on using the virtual prototype as an evaluation tool

When using the co-discovery method, the multimedia presentation worked very well in directing the progress of the situation, and the informative features of the virtual prototype worked sufficiently well to prompt discussion. Some key features of the concept were not credible enough to end-users, they thus speculated about whether the feature in question would be at all useful to them. In this situation a more functional presentation of these features might have made a difference to the resultant evaluation. The co-discovery method is reliable in that it
requires that participants be personally invited to participate, and it provides rich material for analysis. The transcription and conducting of the evaluation situation are, however, time-consuming.

The web and laptop-based kiosk methods appeared similar at first, but in the end the laptop-based kiosk seemed to be a more reliable tool, because technical support was provided and problems were minimized using a pre-configured laptop. The laptop-based kiosk was, however, a disappointment, because even if the employees were given permission to take part in the evaluation during certain working days, for some reasons, maybe shyness about doing the evaluation in public, lack of information, or hectic work schedules, they did not participate in such numbers as we had anticipated. Thus, in order to get enough data from this method, it was decided to carry out the evaluation at a fourth company using only the laptop-based kiosk version of the evaluation. This time, employees were told to take part two at a time. These end-users worked on separate computers and had the support of a technical adviser, who also made notes on the situation and on possible problems. So, in the end, this method was almost as time-consuming as the co-discovery method, in which participants needed to be assembled in advance. Working this way there were hardly any technical problems, because support was available.

The web-based kiosk was intended to collect more evaluation data than the co-discovery and laptop-based kiosk methods did. In this respect the web-based kiosk was a disappointment, since participation was much lower than expected. The web-based kiosk was the most challenging method, especially in terms of the tool’s usability, since the biggest challenge was to make the tool available to employees through the Internet and to get it working correctly on the participating companies’ networks. There was some feedback that confirmed our speculation that inadequate user rights and skills prevented installation of all the required software plug-ins. The other challenge with this method was simply that employees had neither personal computers nor the skills to use them. Another factor could be the lack of motivation to participate, due to the evaluation relying on a wholly independent process.

Both the web and laptop-based kiosks reliably saved the answers to the database, and the gathering of the quantitative material for analysis was quite rapid. Still, the questionnaire needs to be developed to get the gathered data into an appropriate form before analysis. The web-based version needed to make it possible to continue the evaluation without having to start from the beginning after logging off the website, since the evaluation process overall involves a considerable number of questions to be answered and materials to acquaint oneself with. Reducing the number of quantitative questions and focusing them is one of the challenges of developing the evaluation method to make it work faster with the clothing concept, the presentation and the virtual prototype. The virtual prototypes involve the same informative challenges in both web and laptop-based evaluations, since both methods are based on independent observation without further explanation from the researchers. It seems that the low participation in the web evaluation could not be due to insufficient informative features in the virtual prototypes, since in the laptop-based evaluation end-users only asked a few discursive questions, in which the technical support staff were not allowed to take part or explain, and yet it was still possible to conduct the evaluation. With the web-based method, the most challenging and, at the same time, the most crucial features are the technical and accessible usability aspects of the interactive multimedia presentation and the virtual-prototype materials.

5. Conclusion

While a number of experts may participate in the intelligent-clothing design process, it is the end-user who ultimately decides whether the features of the product are appropriate. It is thus
important to obtain feedback from end-users, including during the design process proper, to ensure that the users’ perspectives and expertise are not overlooked. One approach is to engage in a dialogue with end-users to ascertain their experience of evaluating designed concepts from visualizations and virtual prototypes.

The usability of clothing can be developed using a clothing-theory FEA model. The focus can then be on the usability of the garments, rather than on following guidelines to the usability of technological devices - a subject that has been studied more, but which does not offer an adequate way to analyze the usability of the clothing. The FEA model can also be used to developing the virtual prototype for the usability-evaluation tool. This confirms that the model is useful throughout the design process and that it seems to clarify the design process in general. Using a virtual prototype and an interactive multimedia presentation allows usability evaluations of intelligent clothing to be conducted in several ways. Nevertheless, the aimed-for independence requires more than just the successful development of the tool. It also involves inspiring high motivation and making the evaluation as easy as possible for participants to take part, both with assistance and independently.

Acknowledgements

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RE - GENERATE: A CASE STUDY OF A COLLABORATIVE DESIGN RESEARCH -LED NEW PRODUCT DEVELOPMENT
Paul Chamberlain, James Roddis, Sheffield Hallam University, UK

KEY WORDS: Industrial design, Multi-disciplinary, collaborative research, Practice based research, user centred design.

Introduction

This paper highlights the collaborative nature of design and through case studies we will provide an insight into the increasing trend for multidisciplinary alliances. The paper will reflect on the traditional role of the practising designer and suggest how design research within the academy may provide new models and methodologies for working. Key to this approach is the collaborative and multi-disciplinary nature of the research the authors have undertaken. Prof. Rachel Cooper, Editorial Chair of the internationally refereed Design Journal, recently referred to a paper based on a case study of their work. (Chamberlain, Roddis 2003). She says, ‘If we are to consider the future of design methodology, this is a good example of the trend of design leading research in collaboration with social and scientific disciplines’.

The Art & design Research Centre at Sheffield Hallam University (SHU) has played a significant role through collaborations with local industry to take help regenerate, redefine and reinforce industry within the region. The authors of this paper are design researchers who through fundamental and then applied research programmes are making a considerable contribution to industrial product development. Through case studies we will highlight the role of the designer as the ‘mobiliser’ of new solutions.

Multi-disciplinary research activity is generally easily embraced by designers, as Design, unlike many disciplines, is not governed or restricted by context. It provides ways of thinking and skills that can deliver physical objects as tools for creating new scenarios in the world we live in. Designers can create ‘contexts’ for other disciplines to experience and explore. Design is not an insular activity and has to by its very nature engage with other disciplines. A challenge to this approach to research is establishing communication methods that provide a clear understanding between the potentially diverse stakeholders in the research.

The paper will discuss the key role of designers and ‘the physical prototype’, in new product development, outline the diverse current research that has emerged from the projects and draw out the theoretical and practical implications.

Traditional designer - client model

There is increasing literature on new product development (NPD) processes which aims to provide models of practice and identify factors that account for success.

A shortcoming of most of this literature is that it assumes design to be a functional resource directed by management strategically to enhance the NPD process. Much of this literature is produced to educate business managers, it is hardly surprising that it conceptualises NPD as a corporate-driven process which employs the services of design.

Design is often seen as a resource to embellish products towards the end of the research and development process. Once the science has been established and the engineering proven, designers are brought in to add visual value to a product. A traditional view of the industrial design profession is that it tends to be preoccupied with visual appearance, at the expense of
other factors. In the USA, the first industrial designers were known as "stylists", since their chief concern was the cosmetic appearance of products (Margolin 1997, Rothstein 2000)

Adrian Stokes a well respected and experienced industrial designer and Principal of ASA designers provides an insight into collaboration between the traditional client designer relationship (Stokes 2002). He refers to a quote from Dr Rolf Fehlbaum at Vitra, ‘It is my experience that good results can only be achieved in a long term and intense designer client relationship’. There are good examples to support this view, witness Jonathan Ive with Apple, Ken Grange with Kenwood and Dieter Rams with Braun. Stokes describes two strands of communication within a design practice. - between designer and designers and designers and clients. He suggests the best relationships remind him of, ‘a benign game of ping pong’....’what do you think’...’what do I think? Erm well if we’.....’yes but have you considered’......’oh god no I haven’t......’that’s ok just have a look’.... Gradually making okay, good, and good, great and anything after that a bonus and source of regret it wasn’t thought of before the product was signed off’.

However, Jevnaker does provide different models of ‘design alliances’, one of which - entrepreneurial mobilisation - considers the role of the designer as a “dialectical, knowledge-intensive, source of innovation” who can take on an entrepreneurial role in the process (Jevnaker, 1998). Despite high profile examples of design as ‘entrepreneurial mobilisation’, such as Sir Terence Conran or James Dyson, there are few analytical case studies available.

**Designer – user**

“User-centred” design methods have been widely discussed, within product design discourse, and also in the disciplines of human computer interaction (HCI), human factors engineering and ergonomics. McDonagh-Philp introduces us to the following definition of user-centred design:

“**User-centred design is a design methodology that utilises the target product users as a designing resource to increase the understanding of the design practitioner. ”** [McDonagh 1998]

Many business models will assume an understanding can be established through marketing techniques and questionnaires. However there has to be a clear understanding of users needs and wants. If Henry Ford had asked his public what they wanted they probably would have asked for faster horses. Questionnaires can confirm past prejudices and breed mediocrity and dullness. Would the Wright brothers have invented the aeroplane based on a questionnaire? or Edison the light bulb?

If the aim is to improve the usability of products, it is essential that designers acquire knowledge of product use that is derived from first hand experience. In some cases, such as when designing familiar consumer products, designers can draw on their own “real-life” experience of using these products. It is therefore necessary for designers to build close collaborative relationships with product users and, where possible, to take part in user activities themselves.

Quoting from Dreyfuss (1955):

“**I have washed clothes, cooked, driven a tractor, run a diesel locomotive, spread manure, vacuumed rugs, and ridden in an armoured tank. I have operated a sewing machine, a telephone switchboard, a corn picker, a lift truck, a turret late, and a linotype machine.... We ride in submarines and jet planes. All this in the name of research. ”** [Dreyfuss 1955 ]
However, it becomes more difficult when designing products that are used in unfamiliar contexts (e.g. in Hospitals), or for people whose age and/or capabilities lie outside of the designer’s own experience.

**Designer – other stakeholders**

Human-centred design is a broader concept; a holistic approach that explores the relationships between the designer, the end-user(s), and the other ‘stakeholders’ within the system of production and consumption. This may include those who manufacture, transport, sell, carry out maintenance, or dispose of the product or system at the end of its useful working life. The role of the designer becomes that of ‘advocate’, within a system of production and consumption that is socially and ethically responsible (Papanek, 1971).

The authors of this paper are working within a region whose industry has been decimated since the later end of the last decade. South Yorkshire which has a world wide tradition in the heavy industries of steel and coal has witnessed its workforce in these industries since the late eighties decline by over 70%. There are now no deep mines in the South Yorkshire Region. The following case studies demonstrate how the design researchers have ‘joined forces’, establishing collaborative alliances between designers, clients/manufacturers, users, and ‘other stakeholders’, and provide examples of the designer as the ‘mobiliser’ of new solutions. Core to these studies is the crucial role of ‘physical prototypes’ in communication and understanding.

**Case studies**

Rompa – are one of the leading suppliers of products and equipment for special needs teaching and sensory environments. Through collaborative initiatives with clinicians, musicians, and technologists, design led research projects resulted in product outcomes that were subsequently adopted by the company and have since achieved major design awards (Design Council). The relationship with the company has led to the establishment of a sensory research centre within the University

The research agenda has been concerned with the design and development of sensory equipment for people with profound sensory disability and its therapeutic, educational and recreational benefits. An early development from this research was a versatile vibro-acoustic modular system that tries to convey the emotions of music and meaningful sounds to people who cannot hear in the usual way. The portable units can be used individually as stools or in combinations to create beds and floors. The product now named as the tac-tile sounds system™, (Rompa) is a system that delivers sound to a series of resonating surfaces where they are converted into mechanical vibrations which can be felt by people who cannot hear sounds in the usual way. The system has a wide range of uses in clinical, rehabilitation, educational and domestic settings. The system can be used to assist users with impaired hearing become aware of some of the characteristics of speech, music, rhythm and domestic or other environmental sounds in order to help them explore and adjust to a world of complex meaningful sounds. The system allows the users to experience different frequencies, amplitudes, rhythms and intensities of sound and intersperse these with silence.

Establishing a common language between ‘partners’ is essential for the understanding and communication of information. A designer must understand the technical and commercial ‘jargon’ of the client and end user to both develop the question/s and then appreciate and understand what the answer/s mean.
Early stages of research and development involved a process of collaboration and communication between the design team, a team of clinical and educational specialists and the end-users, which in the main were deaf children and in some cases, deaf-blind. In short, the problem was that the design team was faced with the challenges of understanding highly specialised fields of clinical and educational practice, and the end-users literally could not hear what the designers and the clinicians were trying to achieve. Somehow the designers had to develop methods of communication that went beyond words. It was through quite literally ‘feelings and vibrations’ that prototypes provided that the research team gained the knowledge necessary to develop the product.

B.Braun. – The Art & Design research centre at Sheffield is currently leading a research project with this major international medical device company to minimise medical misconnection errors.

The increasing complexity of medical interventions and the associated medical devices means that users are required to connect a multiplicity of external tubes to various types of diagnostic and therapeutic devices. A typical patient in a coronary care unit may have as many as 40 connectors. It is not surprising then that errors arise and a recent incident involving the death of a patient who received drugs intrathecally (via the spine) that should have been delivered intravenously (into the vein) has raised concern about the application of a single connector design to a number of incompatible applications. Our research brings together a multidisciplinary team to design and test a new system of medical connectors. There is now significant pressure for research and development into a system of medical connectors that will distinguish between the different routes of delivery, so that misconnection of this kind become physically impossible. The design of a non-interchangeable connector system will eliminate the possibility of misconnection, which has the potential for catastrophic results. Currently more people die through medical errors than in motor related accidents. An easily identifiable system should eliminate the common practice of customised labelling and reduce the time for clinical checking procedures. Clinical practice will benefit in terms of a safer, time saving system and should contribute to a less stressful working environment. The project will lead to a new range of innovative devices and could provide valuable new knowledge that will inform their future product development.

The research brings together expertise in general and regional anaesthesia, critical care medicine (Bradford Royal Infirmary), Psychology and human factors (Leeds University) and industrial design (Sheffield Hallam University) to develop an engineered design solution supported by a novel means of enhancing the discriminability of a new system of connectors through visual and tactile (haptic) cues. B.Braun a major international manufacturer and supplier to the health industry provides technical expertise and will support the route to market.

Models for collaboration

Designers often reflect on their own experiences to inform their work and can provide sufficient skills and expertise to manage and deliver a project. Design collaborations in the traditional sense is largely focused on the designer and manufacturer as discussed by Stokes. However there are many instances where the designer has to venture outside their own experience and will require external specialist knowledge. Designers, like Dreyfuss, sometimes have to create opportunities through collaborations to immerse themselves in unfamiliar ‘real life’ experiences. Occasionally this is not possible as we witnessed in the extreme case of the ‘deaf blind users’ or specialist clinical tasks. Sometimes there are opportunities to ‘simulate’ these experiences but this often requires the designer to establish collaboration with specialists and be creative in their techniques. (fig. 1)
Design research may demand different collaborative initiatives at different stages of a project e.g. Research and analysis, development and evaluation, realisation and route to market. ‘Sub-partners’ may provide a specific and defined role within the research. Partners that may have a more fundamental role and vested interest in the research can establish a more significant collaboration as a ‘joint force’ in the research as a ‘key partner’.

It is interesting to note that ‘key partners’ in the sensory research were initially clinicians, Derbyshire Health Authority’s Ashgreen Centre, a residential and special day care centre and Russ Palmer a Music therapist who himself was deaf/blind. These key partners provided access to other important specialists and users to input useful information to the project. The Design team liaised with technical specialists to inform the project and the Music Department at the University of Sheffield to composers to create customised ‘low frequency’ music for the system. Rompa the manufacturer were a ‘sub partner’ who only engaged in the research at the latter stages of realisation when the work had been trialed and tested. (fig. 2)

As our research has progressed Rompa have become a ‘key partner’ and have now formally ‘joined forces’ with the Art & Design Research Centre at Sheffield Hallam University. Continuing our close collaboration with clinicians and users as well as technology specialists we have access routes to other specialist resources within health and social care, electronic technology and software developers. (fig. 3)
Multi disciplinary collaboration can provide essential expertise and knowledge but it also brings a new perspective and way of thinking to a project. This hybrid of practice, theory and methods can provide real opportunities for cross-pollination. However collaboration of this nature must acknowledge the cultural and language difficulties between ‘partners’. Our medical connector project sees the ‘joining of forces’ of Design, Psychology (University of Leeds), Medicine (Dr Bickford Smith, Bradford Royal infirmary) and industry (B.Braun Medical). Each ‘key partner’ brings their own specialist knowledge and resource that the research ‘team’ can share in. The Design team is co-ordinating activities and will provide the physical tools for research, provide technical understanding and apply the theoretical findings in a tangible solution. Psychology (human factors) provides an important fundamental theoretical underpinning and quantitative analysis. As a ‘key partner’ Dr Bickford Smith provides experience as a ‘user’ as well a conduit to other stakeholders, patients, nurses, stores, purchasing and the CEN committee. B.Braun provide manufacturing expertise and potential route to market. (fig. 4)

Notably in both of these case studies the ‘object’ whether it be a soft model or pre-production prototype has been the catalyst for communication and understanding across contributing disciplines. The ‘object’ has negated the semantic subject boundaries where misunderstandings occur. Even in the world where interactive design software has revolutionised the way we design things the physicality of an object allows engagement and critical appraisal utilising more than one sense

These case studies provide useful models that have been successfully implemented that may help define collaborative multi-disciplinary design research as opposed to the traditional and more established activity of commercial design practice. Much traditional design research is based on the commercial designer / client relationship and a model where a theoretical study sometimes leads to a tangible product output. The authors of this paper based at the Art & Design Research Centre at SHU provide exemplar how ‘the product’ underpinned with intelligent theory can then enable further research within a broad multi-disciplinary context.

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PROBING FOR THE RECREATIONAL HOME. THE CULTURAL PROBE AS A COMMUNICATIVE TOOL FOR RESEARCHER AND USER
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Abstract

How can qualitative, ethnographic and emotional aspects from probe users be mapped at the same time as they get something meaningful in return? This case study has elaborated the traditional use of cultural probes [1] with a selection of ten families with small children. The idea was to evoke thoughts about recreation and living for the probe users while providing information and inspiration to the scientist. This has been achieved partly through the use of collages. The mixed compositions of images and quotations in the collages are thought to give a quick and effective overview over both what thoughts the probe users have about their home life and how they live. The collages have then been handled over to the probe users as a platform for further discussions. The probes ability to work as something enriching and beneficial to the probe users has been further elaborated in a new way.

Introduction
The overwhelming central issue – utopian living

The idea of the recreational home – perfect living – is surrounded by strong notions of demand. An overwhelming number of the products we own and have taken to our hearts are a part of our homes. The home becomes a decisive signpost of lifestyle.

Who we are, or better yet, who we want to be will be understood and interpreted through our home interiors. This is also a fundamental reason why our homes play such an important role in our daily lives. We manifest ourselves through our homes.

We are constantly fed by the idea of “perfect living” in the singular. How well we manage to fulfil our dreams effects our self-esteem. Decoration and furnishing programs, magazines and products continuously mediate ideals and utopian projects that conflict and oppose each other. No one can live up to both the idea of perfect country living and that of central living in exclusive districts in the heart of the city.

Instead of leaving “perfect living” in the hands of professional interior designers and TV-programs like “Extreme make over” the probes encourage their users to reflect over their home environment by themselves in a more pragmatic way.

In this context recreational living is seen as an intellectual and cognitive phenomenon where well-being is based upon how we experience the environment rather then on how it may be perceived from an “objective” perspective.
The elaborations of the cultural probes

The focus is put on context and reflection rather than on specific variables, and on insight and interpretation rather than on trying to prove certain facts. The approach even values uncertainty. [2,3].

Probes have proven themselves to be well equipped to meet methodological obstacles that arise in different home environment settings [1].

In this case study the researcher wants material for inspiration and information from members of a pre-selected group. The probe users’ compensation is stimulating intellectual tasks, new perspectives on their living, or even increased well-being. This might be possible to achieve due to the participatory and the interactive nature of the present probes. These sorts of probes are considered as emotional or cognitive toolkits [12].

Objectives and research questions

Before starting it must be pointed out that this study to a certain extent has two approaches. One that wants to further elaborate and gain experience about the user centred cultural probe approach itself, and one that focuses on how to influence and invite probe users to develop their recreational living.

The purpose with elaborating the user centred probe is to gain knowledge that can be integrated in product development processes and customer relation strategies in the future.

Concerning the users the cultural probes of this study has got yet other four partly unique sub objectives:

1. To develop the probe as a cognitive aid for the probe user to gain renewed control over home interior development. To get an issue revitalized!
2. To test the probes’ ability to work as a remedy to home blindness and try to encourage new awareness for drawing up recreational home diagnoses.
3. To give inspiration and create new reflections, to form a well-reasoned story about home life and provoke new views to arise. To activate members of specific target groups!

The idea of a new sort of “move in probe” was awaken while working with the last probes. The “move-in” probe has been tested but not yet developed and evaluated like the other probes in this study. The objective with this form of probe is then to work as a structuring and diversifying intellectual decision-maker while moving in. Carefully prepared it may help the user to end up with better-reasoned and thought-out interior solutions. In future form it may be internet-based.

Research method

This study has developed a new way to present information from probe users in an inspiring way through the use of collages. Collages have however been used before, and then as a user centred research method for product design [9]. The aim with the collages is to convey an expressive message, to support the probe users to express themselves by providing new associations and metaphors.

The working procedure of this research has been chronological. Below a figure over how the methodological process has proceeded:
The probe users and the cultural probe method

The probe users all live in the Skåne region in the south of Sweden. The reason for choosing parents with small children has been the triggering provocation that arises when they are let to compare the collage made from their home environment with the two collages made from magazines. The magazine collages have been mixed with triggering questions about recreational living. Some research with strong contradicting images to elicit opinions and stories about experiences and attitudes have been done before, [7] but mixing them with phrases in preset collages might not yet have been investigated.

Pilot study

The pilot probe was considered as a sort of antenna for testing the potential of the probe material; how it was to be experienced and above all how it was going to work as a whole. This opportunity to test and check the probe was important. The probe had to be easy to handle even from a cognitive point of view and thereby also easy to understand properly (see Figure 2). Its design also had to motivate the probe user and encourage playfulness and personal reflection.

It was important that the probe should be played down. It would not express the properties of an object put on a pedestal. The expectation and hope was that the probe would be perceived as something friendly and quite funny that the user actively fills with meaning rather than a static collecting instrument.

FIGURE 2: The exterior of the probe
Probes interior content

The probe was intentionally designed to provoke, reveal and elicit some motives behind forming home life. Probes can be considered as provocative kits meant to call forth an inspiring response from people in different habitats. Probes can be used to give insight into how people live their everyday lives [1].

The pictures in the probe collages were taken from a selection of European magazines from 2004, mostly from their front pages. The pictures are all persuasive proposals of stylistic and recreational living home environments. These intriguing interior proposals were then mixed with questions and declarative statements regarding the issue. The collages covered two A3 colour pages. The probe also contained a 27 shot disposable camera, a pencil and 27 numbered pieces of paper. All the items were then packed into the probe bag (12X17X21cm); a chocolate bar and a lottery ticket were also included.

The user of the pilot study

The pilot probe user received instructions over the telephone. The probe was delivered to his house and he was asked to keep it for three weeks. This proved to be a wise decision as he could not show the camera to any of the children without them also wanting to take photos. Because of this, it was decided that future probes would stay in the homes for about a month. This longer period has proven to work well in other studies as well [3]. When the material was returned, the pictures were digitized, appropriate comments were matched to them.

Pilot probe evaluation

British researchers have also pointed out the advantages of letting probe users actively take part in methodological probe development [1]. The first feedback to the probe user was to let him take part in the material when it had been put together. The first synthesis of the textual and visual material was the following A3 collage (see Figure 4 next page).
Research, R&D and products

Joining Forces | University of Art and Design Helsinki | September 22-24, 2005

One should have a floor drain! “One night I had a dream about a kitchen table coated with Teflon”

Why are beams always so hard to find?

Unpractical with the dishwasher next to the stove!

The computer in the closet! At last it is quiet, too bad it is so hard to change CD/DVD.

Clothes directly from the dryer to the hanger. PERFECT!

One had to be insistent to get the whole floor to slope towards the drain; no ordinary company would do it!

View of the church that made us buy the house!

FIGURE 4: The pilot study collage
The interview

A week later the probe user was called and asked some more all-embracing “meta questions” concerning the probe. The technique to discuss collected probe material while interviewing probe users has proven to be a rewarding experience for both researcher and probe users [7].

Some of the questions discussed:
- What was it like to work with the probe?
- Did it give you anything?
- What did the probe appearance express?
- Did you get any new thoughts concerning your living?
- Did the probe feel strict or more like a funny gadget?
- Did the probe work help you to see your home from a slightly new perspective?
- What was most difficult or dysfunctional with the probe work?

Factors that affected future modifications of the probe:
- The probe user wanted more guidance.
- The probe user felt bad about experienced inefficiency during probe work.
- The probe user found it difficult and time consuming to determine what to exclude from the probe.
- The disposable camera felt too definitive and static because it was impossible to edit the photos. “A picture taken is a taken picture!”

Modifications of the pilot study

After scrupulous considerations, the original disposable camera was kept in the probe. The fact that the probe users are unable to edit or look at the pictures after taking them is something of a drawback. However researchers have found that there are technical implications even with newer technology [10]. Other studies have developed probes so complex and bulky that they could hardly fit into a large moving box [0]. Possible probe designs are a broad field, though, directed by the purpose, available resources and time frames present. Probe approaches made by other researchers have for example focused more on understanding and mapping needs of different target groups like i.e. eWorkers and how they furnish their homes according to their preferences and lifestyles [13].

The four next cultural probes

Already at first sight, the probe users perceive ideas about the probe work. In order to get direct feedback about how the probe was first perceived, all remaining probes have been handed over in person. Other scientists have had positive experiences in presenting cultural probes in person as well [0,0].

The issue

The triggering questions are a technique to structure, exhort and invite probe users to think thoughts that they would not think otherwise, and to take pictures they would not normally take. It is important not to restrict the probe users ability to apply own views and interpretations into the probe [8]. Here are the probe questions: (see Figure 3).

- What thoughts arise when you see these arranged pictures?
- How does your home appear in relation to these pictures?
- What makes you feel good? (At home)
- What is your sanctuary?
- Is there really such a thing as perfect living?
- What is a friendly home to you?
- Your home – a locality for service or a meeting place?
• What are you the most/least satisfied with in your home?
• Why does your home interior really look the way it does?
• How does it affect you?

The probes have gradually been updated and modified after the pilot probe; all this in order to reinforce the probes ability to problemize the issue and to provoke and evoke thoughts to arise for the probe user. The predominant objective here is not to collect information. Some researchers argue that collecting inspiration is the most important [0]. Others that the most appropriate use of probes are to collect information [0].

The four first collages

The collages have been shown and discussed together with the probe users; in some cases the collages have then been modified. Pictures of all collages are not included in this paper, but findings from them are included in the analysis.
Here follows the first collage from the sharp probes (see Figure 5).
Joining Forces | University of Art and Design Helsinki | September 22-24, 2005
Research, R&D and products

The toilet cupboard
We have designed all cupboards ourselves!

Most delighted about the kitchen! Plenty of room for play, cooking and eating.

Three rooms in a row! To wash, brush teeth, visit the toilet. A funny solution!

Our home is smaller, messier, more colourful and mixed-up and not as well thought-out and uniform as many of the cold, impersonal, boring and arranged interiors in the collages!

"The collecting shelf". We just like to look at it!

FIGURE 5: Collage 1a
The four final cultural probes

The final modifications made were to encourage the last probe users to concentrate their picture taking to the end of their probe work and to keep the two probe collages when returning the probe. This was done to be able to refer to them as a basis for further discussions during future telephone interviews.

Probes are always a risk; the success of a probe study depends on motivated and collaborative users and their interpretations of the tasks [11]. In this study highly motivated probe users willing to truly engage themselves in probe work are indeed wanted. An inquiry was sent out in A5 format to a number of families with small children all acquainted with the first probe users. The printed inquiry become something of an assurance, an undefined affirmation about engagement in the future probe work.

Findings and conclusions

The probe users have expressed that the probes have been an inspiring experience. The probe content has shown able to work as an activator to revitalise reflections concerning recreation. The collages have been a source for both laughter and reflection. The meta purpose to bring the issue to life has been fulfilled. Some probe users have also described how they started to experience their home life in a slightly new way. One probe user described how he got renewed control over interior development in his home after being able to pinpoint some factors that before had been hidden to him. Other probe users describe how the probe work has worked as a cure against home blindness. The probes seem to have helped the probe users to distance themselves to their home interiors.

Two quotations below:

"The hall again, does it look worse in the camera or do I see it with new eyes?"
"It seems like it // (the probe) makes the familiar strange to me! ”

Yet another probe user told that he now will stop the gradual development from aesthetics to functionalism in his home. He have decided that he needs a aesthetic spot in his home in order to relax from effectiveness and stress. This probe user has reached awareness enough to draw up a home recreational diagnose and cure.

When looking at the user collages one gets a clear picture that it is the unique details in the home that are important when it comes to recreation. Custom-built features give self-esteem and well-being. The feeling of being able to influence the home environment in a unique way.

An example from a content probe user:

“One had to be insistent to get the whole floor to slope towards the drain;
no ordinary company would do it!”

The probe users also talk a lot about self made solutions as something important for well-being. Below an example:

“The bathroom cupboard! We have designed all the cupboards ourselves.”

Another thing often mentioned by the probe users is functional storage. Below text examples of a new and an old storage solution from one probe user:

“IKEA’s telescopic laundry basket is just so good!”
“Cupboards this practical are probably not made today.”
An overall finding about recreational living extracted from the user collages is the importance of “a heart in the house.” When the probe users write and talk about well-being and the heart, they do this in a double sense. There is both a spatial and an emotional side.

“It must look friendly, it must have a heart, a feeling that people live there, are happy, laugh and play together.”

“I am comfortable at home when I feel that the children feel good, that creativity is given enough room, when the atmosphere at home is funny and cosy. This is not possible in a cold home that looks like an exhibition where perfectionism and cleanliness is more important than anything else.”

**Analysis**

The probes in this study have fulfilled their objectives. Creative thoughts have arisen in the head of both probe user and researcher.

The inviting provocations of the two magazine collages have also made the probe users form a story about their home interiors. In this way the probes has worked like a home recreation activator.

The figure below shows the analytic division between two conditions behind experienced recreational living. They cannot be isolated from each other since they also represent the division of body and mind. From this one can extract that it is impossible to determine if a home environment is recreational for its inhabitants by locking at it simply as a material manifestation.

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**Here follows some positive effects from using probes as suggested by this study.**

- Editing the probes to user collages is a stimulating process
- Probe work instructions made (*Instructions through triggering questions*) do not restrain the probe user
- It is easy to deduce findings
- Encourages new reflections to arise
- Convenient for group discussions and sessions
- It is easy to get started and perform well in probe work as the research question is made vivid
- The triggering collages invites and engages in an effective way
- The task do not appear to be to complex, strict or to academic
• The probe leaves enough room for own interpretations and ideas
• Encourages new reflections to arise
• It is effective to present visual and textual information together
• Photographs and selected short quotes reveal everyday realism and authentic situations and give an intuitive and expressive overview
• It is quick and easy to deduce findings and “scan” to support design
• Leaves enough openings for subjective interpretation and insights well fitted in the early phases of design
• Encourages new reflections to arise
• It can reveal and add new sides to user understanding

Future research and application in industrial product development

This study has further developed the use of cultural probes. In industry, a deeper knowledge about users is becoming more and more decisive. Pre set written surveys and interviews are simply not enough. In early phases of product development, more traditional methods are apt to miss out unexpected but important information. Consequently they need to be complemented with mediating tools that are able to elicit information of importance for more innovative solutions. Probes also have to be further elaborated to better explore the complex and changing nature of different target groups and users. The present study has been an attempt in this direction.

There are different kinds of future applications of cultural probes working with the form of collages and continuous interaction with users described in the present study. Probes might encourage and support an empathic dialogue between design teams, researchers and users [7,14].

Another interesting future application might be to develop internet-based probes for customers to download and submit. This would help customers to map and analyse latent preferences and hidden needs, perhaps even awake or reactivate slumbering desires. For the home interior manufacturing industry, this would provide an intellectual tool to reach well-founded and reasonable home environment solutions and sets of product choices.

Probes could also be developed as communicative tools as part of regular equipment of users in working environments. By use of probes, workers could map perceived risks or moments of discomfort while working. Further weaknesses of cognitive interfaces of various products could be documented and mapped at use in order to improve future products and environments, of advantage for users as well as companies.

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Keywords: research by design, prototypes, performance, protocols of communication

This paper defines a field of operation for recently initiated research project *Prototype development within architecture*¹, through the activity of the Krets research group and by references in related fields. Key issues are how the prototype transgresses borders between design, production and performance and how it can act as a protocol of communication, internal and external to the design process.

**Krets**

Krets is an architecture and design research collective², interested in the architectural project as an investigative tool, with a focus on the material and technological as well as the social and the cultural aspects of design, production and performance³. The collective uses a collaborative platform to explore new modes of production and performance where the nature of design within practice and research becomes reconfigured.

Krets follows an innovative approach in which the potential of a given material⁴ is explored as opposed to specification driven design and goal oriented research. Series of investigations are conducted through prototypes, as parts of a design project, further developed into architectural proposals. The prototype is the basis for collaboration within the group, performing as a platform for experiment and communication as well as an archive of developed concepts and proposals. It operates in different media, ranging from physical or digital models, through drawings and diagrams to operational installations, accessible by external parties.⁵ As opposed to the idea of the prototype as the test result of a process, or a template for others to follow, the prototype is used within the process. The prototype must therefore both perform and be deformable.

Krets has the dual agenda of developing new modes for explorative working methods within practice and to find new definitions for project and design based research. This approach entails that the prototypes developed are seen as not only means towards a design proposal but also as investigative tools for a wider research. The research group operates in different contexts as a collective. Individual members are active in research and practice outside of the group.

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¹ The author initiated this research project in the spring of 2005, working towards a technical licentiate, at the KTH School of Architecture.
² Krets was established in 2003 and consists of architects Marcelyn Gow, Ulrika Karlsson, Pablo Miranda, Daniel Norell and Jonas Runberger. Supported by the Academy for Practice-Based Research in Architecture and Design (AKAD) and presently active in the academic field, affiliated to the KTH School of Architecture. [http://www.krets.org](http://www.krets.org) [http://www.akad.se](http://www.akad.se)
³ The connotation of ‘performance’ is multiple: indicating the establishment of new relations between a designer (performer) and a consumer (audience), as well as the performative and responsive qualities of a specific artefact or environment. When applied to prototypes it indicates its capacity to react to stimuli and give feedback to design implementations.
⁴ Projects are often initiated in an interest for a cultural phenomenon, a situation or a technology used in other disciplines.
⁵ In this way the Krets prototypes shift between abstract states, with design team protocols, to more open states in which guests can participate.
Architectural practice and research

One approach to the problematic dichotomy between theory and practice within architecture has been to look for a theory of practice. A number of contemporary practices today have adopted a working model of ‘thinking as doing’ in which the architectural project is an engine for innovation. The approach requires the establishment of a learning organisation in which a practice ensures the continuous development of its operation. Today innovative work within conventional architectural practices in general is primarily conducted through open or invited competitions. Management that promotes innovation and development during daily work is rare. The discipline of architecture is often considered to be unique and few associate to other fields, even though conditions may be similar.

Former Royal Dutch/Shell manager Arie de Geus speaks of the Living Company as a model for companies that act as an entity, and the Learning Company, sensitive to its environment. Important tools are simulations and scenario planning, meant to be used as instruments for foresight, not for producing predictions but changing the mindset of the people who use them in order to prepare for unforeseen developments. Other important features include ‘transitional objects’ or toys, allowing simulation of reality through playing, which as opposed to gaming does not have a winning move, only an experience. Like prototypes, scenarios and transitional objects are grounds for innovation as well as collaborative platforms for mutual understanding between members of an organisation. The prototype should, as a toy, entice the user, encouraging participation.

Architectural theorist Michael Speaks has defined practices with “high design intelligence quotients” as bodies that look for opportunities to explore new fields within any given problem, establishing alternate and parallel design agendas. Looking at experimental practices at the periphery of the architectural arena, Speaks argues that practice may shift in the near future, driven by similar interests and forces as Geus’s Living Company. Today these practices exist outside of the traditional building discipline, operating through conferences, competitions and exhibitions, requiring a mode of operation that incorporates alternate parameters for design. A fundamental prerequisite for this type of agency, according to Speaks, is that “the relationship between thinking and doing becomes more and more blurred so that thinking becomes doing and doing becomes thinking, engendering highly collaborative, interactive forms of practice”. He further argues that an approach based on prototype innovation allows addressing existing but unknown conditions that enables the discovery of opportunities that could not be predicted in advance.

Architectural representation with prototypical qualities

Prototype development within architecture is related to recent developments within product development, programming and other disciplines with a design component. Rapid prototyping is already an important tool for many experimental practices. Architecture however, rests on a tradition in which representation has become highly refined and a language in itself. The plan, the section, the elevation, the axonometric, the perspective and the model are used on a daily basis. 

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7 Ibid., p. 81, citing D.W Winnicot, Playing and Reality, in which the author coined toys transitional object as allowing a child to experiment with reality without fear of consequences, helping the child to transit from one level of understanding to another.
8 Speaks, Michael, Design Intelligence, article in exhibition catalogue of Latent Utopias: Experiments within Contemporary Architecture, steirischer herbst 2002, p. 73. Speaks has also investigated practices performing in this way in a series of interviews titled Design Intelligence in Japanese magazine A+U during 2003.
basis and acquires material qualities for the architect when dealing with predictions of space, operating at a distance from the architectural object. This process could be infused with a prototypical approach in order to promote innovation and to further refine the design process. The prototype bears many resemblances with the ‘working model’ as opposed to the ‘presentation model’. In order to distinguish the characteristics of the prototype, both in relation to the term prototype as used by other design fields, and the way the model is used within architecture, definitions of the two will be reviewed.

Architect and researcher Anders Johansson sets up three important criteria for his definition of the model. 9 It has a “distinct purpose in its use”, it “is possible to manipulate over and over again” and it “must be possible to see as a world, and be an entity in its own right”. He also states that a model is a (secondary) system that represents another (primary) system, “used when the presentation of the primary system in itself is not available…”10 An important aspect of the model is that it is accessible and possible to manipulate, it must therefore be developed into an articulated system with internal characteristics.

In the case of the architectural model, Johansson assumes that it’s created with the purpose of making a change in a physical space (primary system) possible. The model (secondary system) is created initially as a representation of this space. Changes are simulated by manipulation in the model, later implemented in the primary system, requiring a necessary relation between the primary and secondary systems. The model is the laboratory for experimentation, momentarily suspended from reference to the primary system. Johansson also describes the possibility of the process of model construction bringing about a deviation from reproduction of site, resulting in the model being cut off from the represented space, and acquiring the status of a ‘work’ in itself. This deviation entails that the model must acquire characteristics that makes it self sufficient in some aspects, not unlike the prototype.

Michael Schrage, co-director of the MIT Media Lab's E-Markets Initiative, defines the prototype as a way of “communicating how organizations use media to manage their innovation processes.”11 He further declares prototyping to be a multimedia process in which prototypes are developed in steps. The media chosen has high effect on the design environment and may even evoke new designs. The prototype both answers and raises questions. It’s not the product of a methodical development path; instead it “emerges from interactions around iterations of the prototype”.12 The innovation process does not come up with finished prototypes; the prototypes themselves drive the innovation process. Schrage concludes by asking himself how organizations must change when the prototyping no longer deals only with individual products, processes and services but also with hybrids that raises fundamental questions about the organization itself. This would also apply for architectural research and practice alike, with the development of alternate discourse and methodology.13

Experiments in Education

When addressing the learning organization surrounding innovative design work, it is interesting to make comparisons to design education. Recent years has seen a new found interest in

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10 Ibid., p. 43
12 Ibid., p.128
the pedagogies of architectural training.14 Marc Angélil directs the first year of architectural training at the Swiss Federal Institute of Technology since the mid 90’s, establishing a new pedagogy in which the experiment has become an important feature, bringing unforeseeable qualities and allowing new venues and territories to be explored. The working environment of the design studios is described as a mix between a forum for debates, a library, a drafting room, a workshop and a construction site. Three modes of praxis are distinguished: the technical praxis concerns how analytical and material techniques are put to work, the intellectual praxis puts emphasis on the understanding of design as a strategy for the production of thought, and the intuitive praxis promotes invention through intuitive and associative thinking subjected to critical analysis.15 The pedagogy of this first year of training is aiming at taking on the ‘how’ one can design to continuously redefine the ‘what’ and ‘why’.16

The year starts with intense design exercises, revolving around the theme of space, program, power structures and technology. Finally this production is formatted into “process-portfolios”, establishing connections between disparate fragments through a process of mapping the development. The produced material in form of drawings, sketches, models, diagrams and maps is treated as a territory for exploration, as this post-production assembles all material into one ‘work’ with diverse paths of interpretation.17

The work then turns to a more overlapping series of explorations initiated through a provisional map of an urban territory. While providing representation of a territory this map again acts as terrain for explorative work. As the map starts to deviate from reality, through the mix of objective and subjective readings of the city, it takes on prototypical qualities. Groups of students collaborate on maps which must be able to negotiate different approaches and interests, and operate as systems in motion. Finally, individual work within the framework set by the collective explores the term ‘program’ in relation to function and narrative events. Disregarding the traditional way of producing one final proposal, students produce a series of alternate propositions. The prototypes emerge through collective and individual work and manage to encompass an urban analytical approach as well as a projective innovative approach. They shift from abstract representation to propositional form, based on speculation of human behaviour and forces at work in urban development, maintaining an ambiguity through the multiple proposals.

14 Krets members have conducted several innovation-driven courses at the KTH School of Architecture since 2000 ([www.runberger.net/teaching.htm](http://www.runberger.net/teaching.htm)), as well as a series of workshops internationally.
15 Angélil, Marc, *INCHOATE, an Experiment in Architectural Education*, Swiss Federal Institute of Technology, Zürich, 2003, p. 29
16 Ibid., p. 11
17 Ibid., p. 295
The PARCEL project

The PARCEL project\textsuperscript{18} emanated from an interest in the temporal aspects of disposable articles and printing matter. Prototypes were set up to study the structural aspects of folded paper and plastics, the potential of printed circuits and the cellular intelligence of programmed micro-controllers, aiming at finding spatial and architectural implementations produced by well-established methods within the packaging industry.\textsuperscript{19} The cellular principles of the programmed intelligence suggested a similar approach to the physical components. A system of partially folded units with specific curvatures and sets of folds was developed, in which the structural logics gave a vertical positioning, suggesting the idea of a wall paneling system. The units retained qualities of the sheet, while achieving volumetric capacity with a striated and non-uniform expression. The name PARCEL originates from the way that the singular units are partially enclosed, enabling them to contain electronics but not hiding them from view, as well as the distribution of parts.\textsuperscript{20}

The production patterns developed were used as master for the punch tool setting cuts and fold lines, original for printed circuits and instruction for electronic components. In essence, the complete information for the production of one PARCEL unit was integrated in a single drawing. In this way the formal logics of the PARCEL prototypes were imported from printed matter and disposable articles, transferring their qualities to an interior scale\textsuperscript{21}. The punched plastic sheets were equipped with computational intelligence through the programmed micro-controllers, microphones, LED lighting and speakers.\textsuperscript{22} When combined, the wall-paneling system integrated information technology and infrastructure as well as illumination and sound.

\textsuperscript{18} A Krets project is defined as a field of related collective research, often based around series of prototypes. The PARCEL project was developed by Krets members Pablo Miranda, Daniel Norell and Jonas Runberger in 2004.

\textsuperscript{19} The prototypes encompassed structural cardboard models, material studies of conductive paint, tape and glue, algorithms and electronic component configuration, setting up a number of different venues and protocols for the collaborative process.

\textsuperscript{20} Parcel; to divide into parts and distribute. To make into a parcel; package.


\textsuperscript{22} The materials for PARCEL include: Punched and folded PVC sheets, Screen printed acrylic, Printed circuits, conductive foil and glue, programmed algorithms in microcontrollers, LEDs, Plastic membrane speakers, microphones, diodes, power regulators and resistors.
Renderings of conductive paint as printed on unfolded PARCEL unit and the assembled electronic network with and without visible units.

The local digital conduits within the single PARCEL unit form a network with all other units when assembled into an installation, with physical connectors also closing the electric links. The physical and electronic architectures were both a cellular and parallel model, as opposed to traditional sequential computer processes. The sheets created depth from surface, and picked up the background color of the surroundings, reinforcing this. In addition, the printed conductors were present as abstract patterns, providing PARCEL with an operative ornamental character.23

The immaterial reactive characteristics of PARCEL are based on white noise, often used to control sound conditions in an environment. Surrounding sound is picked up locally through microphones to be dispersed to other units of the installation through the integrated network. During this transfer the sound signal is transformed by other inputs and emitted through loud speakers and LED lighting, establishing local environments. The interchangeable units of PARCEL, each with specific formal and operational characteristics allows dynamic recombination by users/visitors while the installation is in operation. The striated pattern of the complete installation can be reconfigured at will and the emergent behavior of the distributed intelligence in the local environments changes.24

The transfer of strategies from other fields to an interior architectural scale introduces an oscillating ambiguity between graphic and spatial infrastructures. The multifunctional quality of the graphic pattern as instruction for production suggests an ornamental transition from graphic to electronic to spatial infrastructure. PARCEL blurs the relationship between model and building - in this case the wall, and prototype and product - in this case the wall panelling system, in its capacity to continuously react and interact electronically with its environment, as well as invite the visitor to recombine and transfigure the system.

PARCEL has been publicly presented at the Stockholm Arts+Science 2004, the Design på gång seminar at the Stockholm Cultural house arranged by the Swedish Association of Architects (2005) and the first Dorbot-Sthlm event (2005)25. The PARCEL project was developed with support from AKAD, The Academy for Practice-based Research in Architecture and Design affiliated to the three Schools of Architecture in Sweden; KTH (Stockholm), LTH (Lund)

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23 The first PARCEL installation was implemented in the Stockholm Arts+Science 2004 event, at the Stockholm Concert hall. The vibrant green color of the interior walls behind the installation was sampled, and printed on parts of the folded pieces. The conductive pattern also played against the ornamented interiors of the foyer in which it was located.

24 At this stage, the PARCEL prototypes are open to participation by outside parties.

and Chalmers (Göteborg). Special thanks to: Erik Hökby, Mattias Rubin De Lima, Lars Åstrand, Vinkplast AB and Packningar och Plast AB.

In PARCEL Krets addresses the component level of architectural production on an organisational, productional and performative level. The rational building industry of today is based on components with very specific geometry which shapes our environment. This, and the tendency for closed systems for prefabrication in the search to cut costs for architectural production, limits the choices of innovative architectural design in a profound way. There is a necessity to find meeting points between the practices in the periphery of the discipline and the traditional building industry. The Swedish building industry has recently showed a renewed interest in Lean Production and mass customization. Core principles from this approach within the vehicle industry incorporate continuous learning and development through a learning by doing attitude, in which all affected parties take part, as well as a focus on production as the value generating activity. Perhaps these methodologies could be applied to architectural production, including the ‘product development’ aspect of architectural design, as a mode of operation that can provide new opportunities for innovation?


During the spring of 2005 the author has participated in conferences and workshops on this theme arranged by the Swedish Association of Architects as well as the Swedish National Board of Housing, Building and Planning, and is also co-author of a forthcoming report on Volumetric Housing Production, supported by the later.
MAKING CONSCIOUS THE PROCESS OF INDUSTRIALISED ARCHITECTURAL DESIGN
Anne Beim, Kasper Vibæk Jensen, Royal Danish Academy of Fine Arts, Denmark

Introduction

Context

Increasing global complexity at all levels of society seems to create a growing need for simplicity, clarity, control and reliability. At the same time a new consumer culture calls for customized goods. Due to this development the traditional architectural design process is put under pressure by a demand of exact definitions of the values and qualities produced by the architect. Contemporary architecture seem to be ruled by a mixture of different quality standards and means that do not relate to the architectural project as a whole, but is determined by a series of external conditions (product demands, value-chain definitions, technologies and desires of end-users), that are detached from the specific architectural context. Today’s architect is no longer considered as the all-embracing figure of the building process, but is often reduced to the role of ‘yet another consultant’, who mainly deals with issues of aesthetics and ‘style’. Construction management, project planning and control are often in the hands of technical consultants (engineers), in isolation from the designing architect. Thus, there are more links in the chain of communication, and questions concerning construction are further removed from the design process and the design intentions. The result we too often observe is an architecture lacking of coherence and integrity.

Architectural quality is here defined as both objective and subjective matters such as; delicate materials, proper construction solutions, the ambiance of a room, the sense of balanced proportions of a facade system etc. It includes technical aspects, aesthetics, functional schemes, economy, ecology, time, place and other values. Architectural quality forms a synthesis of these elements and can be characterized as a holistic perception of our physical environment, where every constituent part seems significant and irreplaceable within a particular setting. This means that architectural quality cannot be expressed as a single formula and that it is not possible directly to compare different levels of quality between different objects.

The project takes special interest in the architectural potentials, which lies in the use of modern industrial manufacturing processes when it comes to flexibility and customization. Due to modern computer technology and manufacturing the building industry is no longer constrained to monotonous mass production as in the past. However processes linked to industrialized manufacturing and computer technology which both involve carefully planned input and a predictable output seem to confront the concept of architectural quality as well as the iterative nature of the design process.

Purpose

These circumstances as referred above are difficult to change overnight, but greater awareness towards defining architectural quality and more consistent and conscious use of design methodology may help the architect to direct the resources and formulate explicit design strategies in order to reach certain values.

The object of this project is to contribute to this consciousmaking by examining the production of architectural quality within an industrial context. Questions that are studied are: How is architectural quality defined in specific architectural solutions, how intentionally is it being used among practitioners and finally which strategies and methods are being used in order to reach specific goals (architectural qualities) in the production of architecture today?

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Progress

Through detailed interviews with practicing architects the project examines how and to which degree design strategies are used in the attempt to attain specific architectural qualities. All the architectural offices that have been interviewed present interesting attitudes to industrialized architecture and the following analysis tries to decipher how they work in order to reach their final results. We define industrialized architecture as the overall building concept, the production process, building systems, as well as (industrial) design principles leading to particular results.

A theoretical model

As part of the project we have developed a theoretical model consisting of four approaches for action, which helps to categorize and structure the different ways in which the offices try to control the design process and the end-results. The approaches are not meant as exact representations of any empirical reality, but are an attempt to collect a series of related motives for action, sorted out as clear-cut strategies. They are used as a tool in the analysis and in the discussion of the empirical results reflected in the interviews, but at the same time they are also an outcome of these interviews. In this way the model is meant more as a dynamic tool than as a rigid framework. Through the work with the analysis the model has constantly been corrected and refined. The intention is to make the model useful outside this specific research project and furthermore it is meant to create consciousness and discussion among practitioners and students about how they work.

The four approaches contained in the model are named the pragmatic approach, the academic approach, the management approach and the conceptual approach. Each of them represents different strategies along four sets of dichotomies. These are: architecture as an autonomous vs. conditional discipline, project vs. process orientation, innovative vs. evolutionary working method and intuitive vs. explicit accumulation of knowledge.

Autonomous vs. conditional

An autonomous architecture is an architecture which is exclusively defined within itself and the architect is in control when it comes to decide what is relevant to include in this definition. This has to do with a conception of architecture as a true profession rather than an occupation (demarcation vs. action). On the contrary architecture’s dependency places the architect as one actor among many others in the production of architecture. This is not necessarily limiting the development of architecture; the blurred borders can be seen as opportunities and inspiration rather than limitations.

Process vs. project

This axis describes the focus of the architects when at work in the studio. A 'process focus' starts from the assumption, that controlling the process is the best way to control the result. Your actions influence the final outcome. This means that the working methods often have a general character directed towards how you do, which is not necessarily linked to any special features of the actual project. The 'project focus' concerns – the project. This makes the process more arbitrary or improvised in the way that ‘anything goes’ to reach the goals set up a priori in a specific project. The end result can be an outcome of many different processes. The working method is thus postponed in relation to the product/project.
Innovation vs. evolution

The third dichotomy spanning from innovation to evolution is related to the use of knowledge in the generation of new ideas. Innovation has to do with the ability or the intention to throw away what you already know and take in completely new information without prejudice. This knowledge can be both consistent knowledge generated in external environments and more ad-hoc based knowledge generated by a specific combination of conditions linked to the specific case. Evolution means that the actor (the architect) holds the main part of the knowledge or information employed in a project already at the beginning of the project. Compared to nature itself evolution is based on mutation where minor corrections and refinements make an organism (or object or process) more apt in a certain environment, context or situation.

Explicit knowledge accumulation/intuitive non-explicit use of knowledge

The last dichotomy deals with the nature of the knowledge used or could also be illustrated as the media and code used for information storage and exchange. Explicit knowledge accumulation mainly uses external media and universal codes e.g. paper/pen (media) and letters/English (code). This type of knowledge accumulation facilitates communication and exchange by making it more independent of the actors involved in this communication. By intuitive non-explicit use of knowledge is meant that the media is the actors themselves and codes are personal or at least limited by personal access. This knowledge can be conscious but are more likely to be part of the subconscious.

The four approaches of the theoretical model can briefly be described in the following way:

The pragmatic approach

This approach starts from the belief that you deal with the present conditions - good or bad. The role of the architect is not to change the world, but her mission is to present qualified proposals and improve the general standards. Knowledge is collected through a kind of apprenticeship based on routines and tradition and it is developed through working with specific projects. Knowledge is produced and held by the involved employees in each project. There is no systematic cross-project evaluation and transmission and you deal with what is possible within the given frames and conditions. Objectives concerning architectural quality are defined during the programming and the sketching process. Summing up the pragmatic approach is to see architecture as a conditional discipline. The approach is primarily 'project oriented', based on tradition (evolution) with an intuitive non-explicit use of knowledge. A caricature: the craftsman.

1 Knowledge collected from other related or non-related fields
2 Again reality will always be somewhere in between. You cannot start completely from scratch even if you wanted to. There will always be reuse of some basic knowledge e.g. how to use a pen or the dimensions of the human body (in architecture). On the opposite total reuse will not generate new ideas (and will not even be evolution).
3 Universal codes do not exist. In this context universal should be understood as ‘shared by a large number of individuals’. Even shared codes will contain an interpretative element.
4 An extreme way of attempting to surpass this personal access could be the use of torture.
5 The actual knowledge accumulation will always be a combination of the two extremes. This has to do with the interpretative act, which will always be involved in the translation of any form of information independent of media and code into useable real-time knowledge. It is not without importance who is reading a text or looking at a drawing.
The academic approach

Behind this approach you will find an understanding of architecture stressing the ordering of information. Only the architect can fully get a hold of this complex, which nevertheless is created through interaction between various parties each one contributing with specialised knowledge. The role of the architect is to interpret and synthesise the many different inputs. New knowledge is systematically gained and critically held up against present knowledge. A strategy is to use well-known solutions (typologies) that are repeated while continuously adjusted and refined. The different tasks are specified so that responsibility easily can be distributed. Objectives concerning architectural quality transcend the project level as e.g. sustainability, lower costs or daylight qualities. Through a fixed method one tries to reach specific qualities. Summing up the academic approach claims architecture’s autonomy. It is primarily process oriented, based on tradition (evolution) and has a high level of explicit knowledge accumulation. A caricature: the scientist.

The management approach

This approach consider architecture to be formed by the building industry and the architect has no special status within this context. Efficient coaching and management, rational thinking and good business are essentials to attain good results. Knowledge is based on theoretical models and internal systematically collected experience. The business administration controls the total amount of knowledge as a platform for decision-making. Keywords are: business organisation, specialisation of each employee and controlling or directing each one’s effort. This assures an optimal use of all qualifications within the company held by its employees. By possessing sufficient economical resources in each project as well as in the company as a whole, room for innovation and new ideas to emerge is made. Summing up the management approach claims architecture’s conditionality. It is primarily process oriented, innovative and has a high degree of explicit knowledge accumulation. A caricature: the manager.

The conceptual approach

Architecture is conceived as an art in this approach. Every building must be a unique statement, which claims more than just to be the physical framework for human activity. Every project starts as tabula rasa where a particular concept sets up the framework for possible action. This concept might originate or be inspired by part of reality but generates its own logic. The quality is embedded in the value of the concept, the degree of innovation or the special characteristics as well as in the clarity and consistency of the final result, which also should be able to solve technical and functional requirements. Summing up the conceptual approach claims architecture’s autonomy. It is primarily project oriented and innovative and has an intuitive non-explicit use of knowledge. A caricature: the artist.

The four approaches should be understood as neutral based on the assumption that all approaches can result in architecture of high quality. The approaches are the result of refining a group of related characteristics. Real practice will always be more ambivalent and thus hold different approaches simultaneously forming a complex of strategies.
Implementation and perspectives

The model of action has been presented in various contexts thus trying to agitate for a more conscious strategic approach among architects. There is a difference between not being conscious and choosing not to be and our argument is that given the new and industrialised context as described above there is definitely a need for this conscious choice. This not only seen as a means to empower the architect as a professional person as well as the profession, but rather to emphasize what is more important: the architectural quality. As presented in the introduction the traditional design process is under pressure and in this context it is our opinion that new measures must be taken to insure that design is not reduced to cost control, industrial just-in-time production or building code. These might be important issues but should be submitted and measured against a more wide-ranging approach including all the other important aspects of a holistic architectural design process.

An example

A preliminary attempt to use the model outside the research project was made in March 2005 with a group of architectural students in a half-day workshop. The students were working with a general theme about project design and group processes. First they were presented for the model of action and a couple of examples from the analysis. Then the students had some time to think about and write down their own personal approach using the model and the four theoretical approaches as point of departure. Subsequently each of the students presented their approach. The idea was on a general level to discuss how the personal approaches related to the theoretical ones and on a more specific level to see if the results could point towards different roles among the students in their current group project.

The presentations and the following discussion showed that the students placed themselves in quite similar ways. Most of them identified themselves mainly with the conceptual approach with some resemblances to the pragmatic approach. This implied that even though they as students were in a process of learning they did not claim to use any systematic or explicit form of knowledge accumulation, but rather improvised (intuition) or did 'as they used to do' when they had to start up a project. However many of the students also claimed that a more systematic knowledge accumulation as characterised by both the management and the academic approach would be desirable, but that they had no tools to reach such an end.

One conclusion was that the education at the School of Architecture in Copenhagen is characterised by its historical affiliation with the Royal Academy of Fine Arts and that this affiliation today still has an important impact on the self-image of the architects graduating from here. This does not necessarily correspond to the actual needed or desirable qualifications in a modern industrialised context, but the pattern is reproduced through the practice or at least through the culture and the architectural ontology found in many architectural offices in Denmark and it is therefore hard to change.

Further implementation

An article was published in Arkitekten 6/05 in May 2005 presenting the model for a wider target group of architects in Denmark6. The direct impact was that one of the biggest offices in Denmark asked for permission to use the article and the theoretical model as a basis for an internal meeting on business strategy. Currently (July 2005) we are working on an article meant for the Nordic Journal of Architectural Research focusing on the research methodology

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6 The article can be downloaded (in Danish) from www.cinark.dk (Centre of Industrialised Architecture)
applied in the project. A two-week seminar on project design and design strategy is under development to be carried out in November 2005. Finally a project paper has been accepted at the CIB W096 conference in November 2005 focusing on issues of architectural value in this project. I this way we try to make the project more than a final report to be placed in the bookshelves of other researchers. It is our hope that the model can and will be used by more offices in discussions about strategy and that it can contribute to make more conscious the ways we – as architects or designers – define and try to reach goals concerning architectural quality.

One could ask if industrialisation really calls for a special terminology or design process. Is industrialised architecture really something new or different? We do not think so, but the circumstances under which it is produced – and especially the number of actors involved in the process – have changed considerably making building a complicated affair. The world changes rapidly and the architects and the building sector must develop as well in order to provide modern buildings to modern people who live with a new global complexity that call for clearly defined values. The purpose of this research is not to reject the traditional role of the architect, but to challenge it by making the architect more conscious of her own choices and the architectural consequences of these choices.

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www.cinark.dk
JUST USING THE ELECTRONIC DAILY OBJECTS: NEW TECHNOLOGIES AND/OR/FOR THE USERS
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Introduction

Despite of the many efforts to consider the users when designing interfaces (as it may be seen by following some studies carried out in Human Computer Interaction, User Centred Design, Usability, etc.), a lot of interface design practices already disregard the user’s point of view. To ignoring users has as a consequence, the use of some interfaces that does not correspond with the users’ capacity to interpret them. The aim of this article is mainly to show that some decisions regarding the interface layout of some electronic daily objects are not in agreement with the capacities of the users to interpret them (sometimes users are unable to formulate any hypothesis about the functioning of the house appliance’s interface). Instead of planning by considering the interface and the users as detached parts, designers should consider them as a continuous inseparable phenomenon.

The signifiers and the signifieds

The words signifier and signified are very often used by linguists – overall semiologists (Saussurre, 1995) –, semioticians (Peirce, 1878) as well as by psychoanalysts (Miller, 1987). Although it could be argued that these both terms are slightly different in meaning for each of those theories, it will be enough to explain the adopted concepts within this study by considering the purpose of this paper. It does not matter if there are shared common meanings among those theories or not.

The term signifier was adopted to designate any element that acts as a stimulus before to launch the signifying processes, i.e., signifier is any element that may provoke a process of signification, even if these elements are not already captured by an observer. The term signified was assumed to name the signifier that was captured and is already being processed by an observer toward a representation, i.e., signified is any element from the real that is being or has already been transformed into reality. In these assumptions “real” is defined by the block of accessible elements (signifiers), which are available to be appropriated by an observer, and “reality” is assumed as its representation (signifieds). A block of signifieds is a corresponding model of some part of the real shaped by an observer in a more or less accurate and a more or less truthful way. In other words: the real is made of signifiers, while reality is shaped by an observer to create a correspondent model of the real by means of signifieds.

The construction of the meaning

From a static point of view, the meaning is established like a diacritic block of discreet elements or, to be more precise, the symbolic language is constructed from “elements that they each have their own value only when they are put in relationship with at least another element,” (Miller, 1987 p.28); hence, every single element is devoid of significance. The meaning of an element – or signifieds – is constructed from the perceptual capacities and from the sensibility to the differences existing among the diacritic elements – or signifiers –. The choice of the signifiers that will be translated into signifieds is determined by both the capacity of an observer to identify relationships among elements during his own meaning construction and his capacity to correlate these elements with a restricted possibility of significance.
The abduction starts from lacunas

Peirce (1878) describes, besides the well-known inference processes of deduction and induction, the abduction as another way of inference. Unlike the deduction and induction, which are formal ways of reasoning by symbolical logic processes, the abduction is informal. Informal does not mean illogical, but critical logic thinking. Instead of definite symbolic conclusions, the abduction has as result the formulation of hypothesis that may be used with a minor or major exactness as a provisory conclusion. Abductions are propositions that can be affirmed or denied, while both deduction and induction are assertions that are final judgments.

According to Bonfantini’s (2000), the abduction may belong to three subtypes: (1) in the first subtype the law, which mediates the abduction process, is imposed in an automatic or a semi-automatic manner; (2) in the second, the law of the mediation is chosen within an available “encyclopaedia” and (3) in the third subtype the law of the mediation is an invention and is presented as an ex novo model. All of these three subtypes have in common the presence of signifiers without any signified, which starts a cognitive process.

When it is introduced new signifiers without any equivalent signified, the observer verify a completely absence of meaning and one of the two situations may occur: (1) if there is a small number of new elements, individuals are able to complete the lacunas among the whole of elements with some abducted interpretation (formulation of hypothesis); (2) if there is a great amount of new elements, individuals may not be able to infer a hypothesis, causing to them a cognitive anguish. The first case may be interpreted as an introduction of novelties and the second as a cognitive dissonance. In a summary, the lacunas may be either a gap for filling with some meaning or a missing part that impedes the meaning construction. The pertinence of the signifiers is an important factor that may facilitate the meaning construction. Furthermore, the quantity of missing signifieds (and not signifiers) in conjunction with the capacity of a people to filling those vacant places in order to establish a meaning will also differentiate both situations.

The construction of a sense

If someone says: “Mary is joyful”, immediately a meaning pops up from this phrase but it does not mean that this statement encompasses a sense. The meaning is static (we may compare it with a dot). The sense, instead, is created along the time axis by connecting many signifiers to construct a sequence of meaning (and we may compare it with a line). In fact, Bonfantini (2000) affirms that to establish a sense it is necessary to move along the time1 to achieve a comprehension. The construction of the sense depends on the relationships among many meanings that probably will express a phenomenon’s performance along a period of time, i.e., it gives an overview of the historical aspect to the block of meanings. For instance, if it is said that “Mary is finally joyful”, it denotes an historical sequence. It means that firstly Mary was sad or not so happy and, later, something occurred to bring Mary in a subsequent joyful state. Each meaning in relationship with one another is slightly transformed in order to be more efficient and compatible with the whole sense. So, it is established new values for each meaning directed by a specific sense construction.

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1 It has to be differentiate the conception of “sense line” from the “chain of signifiers” described by Peirce (1878) as well as by Lacan (1995) when they affirm that the people are always compulsorily connecting signifiers captured from the real.
Dialoguing with machines

How does it being introduced new technologies in the users’ everyday life? The Norman’s (1998) words are quite clear when he describes the stages of development of the technological employs. In the beginning, the use of new technologies is conditioned to what these technologies are capable of doing. At this stage, design concepts will be developed by translating the technological requirements into a usable product. It may be inferred that such a design procedure will put in relevance the technology and the product interactivity will be enough to be used. So, the interfaces will be part of a technology-centred product. As an outcome, the interfaces will just allow the use of the device. This kind of objects will attract only who is a technophile (Cooper, 1999; Norman, 1998) or is in need of it (Norman, 1998). Later, in the maturity, the technological companies will do some efforts to pay attention to the users necessity. In favour of User-Centred-Design practices, Schneiderman (2002) states that understanding human needs will accelerate the evolutionary development of useful technology. Moreover, he considers the usability design as the start of a “paradigm shift” and synthesises saying: “The old computing is about what computers can do; the new computing is about what people can do.” Even if the author is referring to computer technologies, his affirmation may be easily fitted to any type of device that uses computational components to allow the human-machine interaction. It can be asserted that the quality of the human-machine dialogues also depends on the stage the useful technologies are, and on how many innovations are being introduced as novelties.


In regard, VanPatter (2005) says that the humans are able to understand something as new only by comparing it to something that they already know. Clearly, VanPatter is talking about the ex-novo model in correspondence with the users’ mental models as the same way as Lynch (1960) says about the standard type. Lynch affirms that when a type is sought by the first time someone may recognize and describe it because it corresponds with a stereotype that was already known. Krüger (1984) presents a typological morphogenesis model (Fig.1), in which he analyses the transformations of the type. In this model, each time that is introduced novelties it means that the actions are running to a disciplinary revolution. On the other hand, when the model is not renewed, the prototype gets marred and runs to a disciplinary stagnation. If a prototype is repeated, it may be said that a socialization process is occurring and it is
evolving for a type, but if the repetition is widely employed what should be a type becomes a stereotype in an obsolescence process.

If someone acts on the stereotype he/she gives a new look to a product, refreshes its characteristics and restores the people’s interest. It is occurring a typological renew. If the model is radically modified from a type to a prototype it is coming about a methodological renew. Needless to say that some users and planners perform a disciplinary revolution and several others look for disciplinary stagnation.

But what does this typological morphogenesis model has to do with human-machines dialogues? When designers set up an interface in a revolutionary way they have to take into account that the users are able to assimilate just a limited number of novelties. A person who tends to a disciplinary stagnation will be probably less able to accept ex-novo models. On the other hand, if designers opt to maintain the elements of an interface already known, it may be disgusting for a lot of users interested in a disciplinary revolution. In the first case, users are subdued to a large amount of novelties, hence they may have some difficulty in establishing a meaning for the new elements, while in the second case users may be regretful with a product that does not offers any of the new elements they aspect. Obviously, designers may not satisfy all of the users’ idiosyncratic differences, thus the ability to define how many novelties should be introduced in an interface constitutes one of the Achilles heel to a good interface design dialogues.

New technologies and the users. When the use of technologies is in its beginning, it is centred to what these technologies are capable of doing (Norman, 1998). So the solutions of interactions are relatively neglected in favour of what decision makers consider as important: better, cheaper, more powerful, unique technology and so on. In this phase technologies requirements prevail on the users’ need. It has not too much to choose from: it may be inferred that the planners will consider the “technologies requirements” AND “the users’ need” as two separated aspects. It may be sustained that in this phase de human-machines dialogues are poorly planned. Norman (1998) says that in this stage, people are just attracted as technophiles or by a great necessity about the functions a device may offer. According to the author, in this phase users are called “early adopters.”

New technologies or the users. In the commencing of an intermediate stage, technologies are mature enough to be taken for granted, so, the marketing strategies dominate the process of planning (Norman, 1998). The staffs try to understand the users’ requests. Hence, the development of the new technologies is directed to satisfy the new features desired by the market. But the companies prepare the market interest saying what is interesting, and powerful, and up-to-date, etc. According to Norman, (1998) the choices about what has to be considered are done through arbitrary decisions and hardly ever the customers’ real needs are addressed. The planners are more interested in solving some technical problems by asking to their customers – or merely supposing – what should be helpful to them, than to actually discovering which are users’ requirements (Probably it would be more worthwhile to inquire to the non-customers users). In this phase the design actions are centred whether in just developing new technologies based on the marketing strategies OR, much more rarely, in the users real needs.

New technologies for the users. Already in this phase users are looking for status and does not matter too much if the products does not have a very good interaction. Despite that, the development of the new technologies is alleged to satisfy users need, and the researches are directed to the new features desired by the market. About it, Norman (1998) complains about the companies’ actions to improve on highly quantifiable measures of performances. Even if the companies’ actions are carried out by means of very strict scientific methods, these researches are solely to be marketably used, disregarding the actual users necessity. What is not
measurable is considered of minor importance. The author says that this is where the computer industries are today: planners are concerned with the development of interfaces FOR the users’ needs, but the word “for” means that the users are passive subjects to whom planners are deciding for. The marketing staff is also oriented by many consumers’ behaviour: convenience and reliability are more important than technological superiority (Norman, 1998). On the other hand it starts to matter the formal aspect, which gives prestige and pride of ownership. Users would never prefer to wearing an inexpensive plastic watch, even if it costs much less and works much better than a handmade watch.

*Design with the users.* To achieve the planning maturity, any product must be planned “with” the users’ participation. This old discussion on design was early treated by Sommer (1983), one of the very first authors, which has considered the people’s actual needs. According to him, the planner’s job should concern with people rather than for them. It is a mistake to think that it is enough to take into account the planners’ suppositions. It is, as well as, a blunder to believe that the scientific studies fixed by the marketing staff are much better than the planners’ suppositions (Norman, 1998). Indeed, the most part of these studies is scientifically correct but seldom deals with relevant aspects to the users’ requirements (Norman, 1998; Cooper, 1999). Surely, many of the electronic daily objects are designed to the market interest, and some of them may meet the users’ needs. To know exactly what should be done to improve human-machine dialogues, the only way is to seeing how people interact with these devices. If a design with the users has to be envisaged the main challenge is to decide which instruments and better skills are capable to modify the current design models.

**The metaphors: alienation or welding?**

Galileo (1610, apud Arecchi, 2003, p.8) stated that the complexity arises from the attempts to logically construct the world. So, if someone says that are living in a complex world and he has to use complex machines, it means that he was trying to organize the world into a logical construction and he has failed. To bypass the discomfort provoked by the unsuccessful endeavor, individuals start a reductionism process. The reductionism process begins when someone starts on to transform the Real into reality. Although there is an information loss, this process allows individuals to get cognitively the complex phenomenon as a whole.

If individuals are not able to conclude a reductionist model by inventing a signified for the ex-novo model, they may: (1) look for analogous situations that are already familiar to them; (2) move their attention to another phenomenon easier to be understood (Kuhn, 1993) or (3) simplify the Real into a disagreeing reality model by constructing a wrong corresponding model (Lakoff & Johnson, 1980). These metaphors may promote, whether a welding by step-by-step construction of a theoretical model (Hirtle, 1998) or an alienation in the individual’s relationship with a phenomenon.

**Between the machines and humans**

Based on Fadini (2000), Pizzocaro (2004) outcrops that, from a systemic point of view, there is not any dichotomy between humans and machines, but contiguity between the natural, alive and the artificial, lifeless and she says that such contiguity begs to rethink about the existing planning categories.

Pizzocaro (2004) also affirms that the fuzzy boundaries between natural and artificial as well as the progressive fade from category to category, pertain to an image of the reality as a unitary block. The current comprehension of this contiguity is not taking into account by designers during the planning process.
Bibliography


